JOURNAL OF GAS LIGHTING & WATER SUPPLY.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

VOL. CXXI., No. 2593.] TUESDAY, JANUARY 21, 1913. [65TH YEAR.

EDITORIAL NOTES.

The Rise of High-Pressure Gas Lighting.

THE gas industry has to move with the times in the matter of illumination as in other ways. The artificial illumination of a past day will not suit the appetite for more light of the present day; and the industry, if it would hold its own, has to bow to the dual irrepressible forces of competition and the tastes of consumers, and, if the consumers be tradesmen, to their knowledge that light is a factor in attracting people, and therefore custom, to their neighbourhoods. The times in this matter require administrators that are at once sentient and enterprising. On this point our convictions have been hardened by a recent investigation in shopping centres in South London. In those centres, tradesmen of all descriptions and standings may be found; and their views may therefore be taken as representative of the views of tradesmen generally. It is found that one might just as well talk to a brick wall as to them of small units of light, and plenty of them representing the best, and most scientific, form of artificial illumination outside their premises. They will readily grant it for interior illumination, but not for outside illumination. There they are the masters of the suppliers of illuminating agents. They want something magnetic outside; something that will, so to speak, turn the evening darkness into the light of day, with the pleasure that rich lighting devoid of irritating effects produces. The South Metropolitan Gas Company (in this enterprise the Chairman, Mr. Charles Carpenter, has been the moving spirit) have recognized this, and in the past two years have been satisfying requirements in a manner that has transformed most of the principal shopping centres in the large supply area. There has been a perfect impartiality in what the Company have done. Every district where there was the opening for high-pressure lighting has now its compressing station and supply of high-pressure gas for all who need it; and to day, on what is now generally known as the "parade" system, the Company can, we believe, boast of more high-pressure lamps installed than any other gas undertaking—company or municipal—in the country. On this system, they had on Dec. 31 some 3136 lamps in use (representing about 3,242,000-candle power), and approximately they had a further 1000 on isolated plants. This is a remarkable showing from the generous enterprise in this direction compressed into the space of two years. From what has been learnt through the investigation as to the views of tradesmen, we believe there is throughout the country a great deal of work of this kind to be done in the interests of the industry, individual undertakings, and supply areas.

The South Metropolitan Company will not claim to be pioneers in this work; but they have a right to credit for an extraordinary amount of enterprise and "push" in their area, which must have a good effect generally upon the industry. They have proved in shopping centres of very diverse character what can be done for themselves, the tradesmen, and the localities in this matter of the provision of more light. Ilford and Tottenham, within their respective opportunities, led the way; and to-day in London and the suburbs there are (without mentioning other systems that may have been adopted) something like 12,000 to 14,000 Keith high-pressure lamps nightly doing duty outside shopping premises, enlivening the neighbourhoods, and maintaining the patronage of the shops of the tradesmen, instead of allowing trade to drift and become concentrated in the localities that offer the greatest attractions. We cannot give the exact figures for the individual companies in London and the suburbs. But the South Metropolitan Company lead in number; the Gaslight and Coke Company are a close second; then succeed the Brentford Company, the Tottenham Company, the Mitcham and Wimbledon Company (now merged in the Wandsworth Company), the Wandsworth Company, the Croydon, Ilford, Hornsey, and other companies. Several of the other surrounding concerns have installations, which raise the total number of lamps to-day on parade and shop lighting in and about London to the 12,000 to 14,000 mentioned; and this total has been reached (if we except Ilford's original installation) within the past four years.

What has produced this great change in outside shop lighting, and this favour of the high-pressure gas-lamps? As previously remarked, an appetite for more light has been created; and the tradesman has learnt by experience the value of artificial light as a factor in business. We must give our electrical rivals the credit for having in part created the appetite for more light.; and they in turn must give the gas industry credit for being in possession of a light to-day that, for its combination of qualities, is the superior of the flame arc lamp. Hundreds upon hundreds of electric arc lamps have been displaced from shops in London and its environs by high-pressure gas-lamps; and this not on account of price only. The verdict of the tradesmen in the South Metropolitan Company's district is that of men who know what they want, and know when they are satisfied. They do not want a flickering, unreliable light—a light that will leave them in darkness unexpectedly, and, as the irony of fate will have it, just at the height of their busy time. They require a good white, and yet attractive, light. To get, by an electrical means, a white light such as they need, they must go back to the old enclosed arc lamp, and that is too expensive nowadays. They want a lamp giving a soft light, and not an unbearable glare. Experience of various forms of lighting has brought a knowledge of requirement to a concrete base; and knowledge of requirement will give the patronage to the illuminant that can best meet it on all points. The tradesmen of South London have gone in so extensively for high-pressure lighting (orders for it now reach the Company without the asking) that their verdict is plain and indisputable.

Included in the article in other columns is the disinterested testimony of the Manager of one of the very large drapery establishments in South London; and what he has to say about the matching of difficult colours by the light of the high-pressure lamp will be read with extreme interest as being the views of an expert. He prefers the quality of the high-pressure gas light for showing the goods in the windows of the premises; and he personally prefers, of all existing small units of lighting—gas and electric—the quality of the light of the "Metro" burner for inside illumination. This, after experience with arc lamps and carbon filaments and metallic filament lamps. The independent testimony is highly gratifying; and we want nothing better. There is an interesting point in this connection to which attention has been previously called, and it is that many of the tradesmen have, on adopting high-pressure gas-lamps for outside lighting, entirely removed the lamps—gas and electric—from among the goods displayed in their windows. Shop window inspection where direct lighting by metallic filament lamps is employed has become not a pleasure, but positive torture to the eyes. The tradesman, through the complaints of customers, is learning that it is not a good thing to rack their eyes before they enter his shop; hence another reason for the welcome given to a dependable form of outside lighting through which they can dispense with interior window illumination, which economy contributes to defraying the cost of the outside high-pressure lamps. Experience is a marvellously good teacher.

From the position occupied by the gas industry to-day in the matter of illumination, there can be no retracing of steps. High-power gas-light has qualities which are becoming more widely recognized; and it is for the managers of the industry to cause the diffusion of the knowledge as much as possible, and to make the most of their opportunities. Success awaits all, with a properly organized system, and a system that unites with it the excellent lamp maintenance that was found in every part of the South Metropolitan area. A long time since it was remarked in these columns that

the day would arrive when a high-pressure system of supply would become an indispensable adjunct to a gas undertaking in its principal centre or centres of supply, and that undertakings other than those of the rural order would be regarded as in the rear of their day and opportunity that had not one. That day is coming along apace.

Statutory Gas Companies in Parliament.

In this week's issue, the review of the measures to be promoted by statutory gas companies is concluded; and there remain those of local authorities with which to deal, to be followed by a glance at the Provisional Orders. Looking critically at the Bills, there seems little about them of a combative nature; and their chief interest lies in the significant way in which they mark certain of the lines of industrial policy. Most of the promoting companies are extending their areas; and there are no less than four of them who are annexing smaller concerns in their vicinity. The Blyth, Bournemouth, Grays, and Tottenham Companies are all absorbing other gas concerns—the last-named the Enfield Company. Such amalgamation is not by any means, as rivals of the industry pretend they believe, any indication of debilitation on the part of the larger undertakings, but rather it shows a progressive strength which enables them to plan consolidation with companies of less power than themselves, and at the same time to confer on the outer districts the benefit of a lower-priced supply, which gives an impetus to the growth of business.

There is a titular change, too, coming over several gas undertakings. This change has been proceeding during the past few sessions, owing particularly to companies obtaining powers to conduct new business supplementary to their main activities in connection with gas supply—for example, by entering into electricity trading. The lengthening of names proceeds. In the non-statutory section of the new promotions, we saw that the Ely Valley and the Porthcawl Companies are asking to be invested with electricity supply powers; among the statutory gas companies, the Crowborough, Herne Bay, Tottenham, and Westgate Companies are making similar application. If the powers are granted most of them will insert "and Electricity" in their titles. But the Ely Valley Company and the Tottenham Company are proposing to make a complete change from the old style. The Ely Valley Company simply contemplate calling themselves the "Ely Valley Lighting Company." That is not comprehensive enough. There is a preference on our part for the proposal of the Tottenham Company. They contemplate calling themselves the Tottenham District Light, Heat, and Power Company. The title is comprehensive and fully descriptive. At the same time, there is a little regret at seeing the disappearance of all association with gas supply from the title of a concern that has made notable history for itself in its rapid development as a gas-supply company. Gas supply will, after all, continue to be the major part of the *corpus* of its business. Still, we like the proposed descriptive title; and to insert "gas and electri-"city" would make it cumbersome.

There is a stand-by clause in most of the Bills—among others in that of the South Staffordshire Mond Gas Company. They have as much right to one as town gas or electricity suppliers. But if a manufacturer has a supply of both town gas and Mond gas on his premises, which will be the stand-by supply? Supposing, for example, the greater volume of gas used is of the Mond variety, but the greater revenue is taken by the town-gas suppliers, which (assuming both to have stand-by powers) will be the stand-by supply? We do not suppose any difficulty will arise; but one never knows who will be, at some future date, the moving spirits of any concern, and the amount of pugnacity that they may possess. The South Staffordshire Company are asking for the right to issue some of their unissued ordinary capital as preference. Unless they can get this power, there is little chance of their obtaining further capital from the public, inasmuch as only 1 per cent. dividend for one year has been paid on the ordinary shares. But in proportion to the preference capital issued in future, the hopes of the ordinary capital holders (who have been hoping on for a decade) will recede further and further; and the 1 per cent. for 1911 will remain a pleasant memory of small degree, with probably something added for the past year. This, however, has yet to be disclosed. The Harrow, the Tynemouth, and the South Staffordshire Companies are including clauses variously relating to co-partnership and benefit funds. The Worthing Company are asking Parliament to disentangle them finally from the meshes of litigation and worry into which they got owing to the interference with a tunnel in the pipe-laying operations connected with their new works.

From this brief statement of the main points in Gas Bills, it will be seen that there is not a great deal that is calculated to raise contest, though the session will not be without its interesting marks and matters.

The Sulphate of Ammonia Market.

When the annual report of Messrs. Bradbury and Hirsch is issued in January, producers of sulphate of ammonia are already in possession of the information as to the financial results of their individual dealings in the commodity; but this fact does not depreciate the interest that is found in learning the incidents of the year that have had their influence on the market, and the visible tendencies that may have their effects upon it in the near future. Messrs. Bradbury and Hirsch (of whose "Review" a summary was published last week) are usually found to be trustworthy guides so far as it is humanly possible to gauge, so soon after a year has expired, the actual developments and facts of the year, and to foreshadow the future. Their predictions for 1912 did not take count of a coal strike, and one of such duration; and yet, in the event, what they did prognosticate would come to pass has, in reality, been in all material respects fulfilled.

For sulphate of ammonia producers, the year was one that gave satisfaction; for the average price was £14 7s. 9d. To find a price superior to this, it is necessary to go back best part of thirty years—to 1884 in fact. Contrary to the experience of some years now, our informants compute there was a diminution in home production last year, compared with 1911, amounting to 6000 tons—the calculated total being 379,000 tons. But their basis of reckoning is of a somewhat unreliable character, owing to the disturbance occasioned by the coal strike. Directly, they attribute to the strike an estimated shrinkage of 15,000 tons in output; but on balance at the close of the year, a diminution of 6000 tons. To iron and shale works the same production is accorded as in 1911; but to gas-works on the one hand and to coke, carbonizing, and producer plants on the other is equally apportioned the total computed reduction of 6000 tons in output. There may be some alterations to make in these figures when the exact quantities are available. We should rather incline to the view that, of any reduction of output, the coke-oven and carbonizing works would have had a greater share on the whole year than the gas undertakings, though fully aware that water-gas plants were put to greater use during the stoppage of coal deliveries, and subsequently till deliveries were again normal. But, in the second half of the year, there were throughout the country some good increases of gas consumption, and we should have imagined that this, the price of sulphate of ammonia, and, in a minor degree, the increased attention that is being paid to the recovery of larger amounts of ammonia per ton of coal carbonized, would have produced a nearer counterpoise between 1911 and 1912 in production in the case of gas-works.

It is seen from the statistics of exports how the absorption power of the markets geographically shift about from year to year. The estimated weight of exports (286,864 tons) is about 5000 tons less than in 1911. Spain, Portugal, Italy, Japan, and the Colonies increased their demands; but the United States showed a considerable reduction—to nearly one-half the requirement of 1910, and near the line of the 1909 demand. The United States being such an erratic market is a good reason for not placing too much reliance upon it, and for not leaving a stone unturned for cultivating new markets, and for stimulating the demand at home and in other countries where the factors that exert influence on the markets are of a more normal character than those affecting the United States. There are other reasons for activity in this respect. Producers do not want to get back to the £10 and £11 per ton era if it can possibly be avoided. There are indications that at the moment prices are not likely to be materially affected; but this is a condition that cannot hope to be continued if the absorptive powers of markets do not grow *pari passu* with demand. Notwithstanding the coal strike at home, the calculated output of the world last year was 1,300,000 tons, compared with 1,178,000 tons in 1911. The facts show that there is abundant work for the Sulphate of Ammonia Committee, which work must precede, and not succeed, increasing output. Year by year,

there will be more sulphate to be dealt with; and this fact must be kept well in mind. However, for this year, a careful scrutiny of the portents suggests that the conditions will be such that round about present prices will be maintained; but it is too much to look for any material appreciation.

Acetylene and Petrol Air-Gas Lighting.

THE papers read at the meeting of the Illuminating Engineering Society last Tuesday, on acetylene and petrol air-gas lighting, are, so far as the points covered by our *précis* go, worth the attention of gas men, especially in those neighbourhoods where petrol air gas has entered into direct competition with coal gas for the lighting of certain large establishments. Mr. C. Hoddle dealt with acetylene, and Mr. E. Scott-Snell with petrol air gas. To give the authors their due, they did not suggest that the field for either of the illuminants which they champion is in the region penetrated by town-gas mains, where the town gas is supplied at a reasonable price. We have never held that they have not—on the contrary, we believe that they have—a field of utility. Both are useful in remote country residences and other establishments; and acetylene, owing to its portability, is applicable to several uses for which at the present time it has no real competitor. The industrious manner in which ingenuity has been brought to bear, with success, upon the perfecting of acetylene plant, is worthy of the best recognition. The light of the luminous flame of acetylene, too, as Mr. W. J. A. Butterfield said in the discussion, is extremely good; and it is on this account, combined with the difficulties encountered in efforts at application, that it is not seriously contemplated utilizing acetylene with mantles (inverted ones especially) in order to obtain a higher efficiency per cubic foot of gas. Having said this, interest ceases, as from the point of view of economy, the labour involved in its preparation, and (practically speaking) its limitation to lighting, the acetylene system cannot be regarded as a competitor of coal gas on its own diverse ground.

Coming to Mr. E. Scott-Snell's contribution to the subject of petrol air-gas lighting, we find him a little assertive and rather prone to generalization. Certainly more proof of some of his statements would be acceptable. Two or three examples will suffice. We are afraid he has taken a long shot, when he says that "the fact that such a large propor- "tion of air is taken into the burner [petrol air gas] through "the pipes enables one to obtain, at the comparatively low "pressure of 1½ inches, conditions of combustion compar- "able with those obtained by high-pressure gas." We should like to hear more specific reasons for this assertion. Again we have him saying that "the size of inverted mantle "commonly used for petrol air-gas lighting [the bijou type] "yields a much more brilliant light than would be obtained "with a corresponding mantle with low-pressure coal gas." There, again, the statement has a somewhat *ipse dixit* ring about it. Mr. Scott-Snell knows perfectly well that the illuminating power (consequently the brilliancy) obtainable from a given area of mantle surface is a result of conditions that can be, in the case of coal gas, varied by the type of burner and the pressures used. There is nothing particular in the point to the credit of petrol air gas; and, as a matter of fact, a mantle of the bijou size that gives (say) 25-candle power is sufficiently brilliant, having regard to the mantle area, for any domestic service. Besides this the mantle of the petrol air-gas burner is subject to several conditions that cause lapses from the highest duty. Moreover, the duty derivable from the bijou mantle cannot be, with petrol air gas, obtained from larger mantles; and on this point Mr. Scott-Snell again steps aside into gratuitous assumption, when he says that this experience will probably be confirmed by those who are concerned with coal-gas lighting. The confirmation is not likely to be forthcoming, as it is not true within limits. Perhaps the author has not been quite so explicit as he might have been; and therefore a little misinterpretation of his words.

It is also remarked from the paper (we must accept Mr. Scott-Snell's own figures for this) that there is a considerable falling away in the illuminating power of mantles used with petrol air gas. He refers to tests carried out with some new bijou mantles, which were giving from 70 to 80 candle power, while others that had been in use in the show-rooms "some hundreds of hours" [how many?] were giving 48 to 50 candle power. That is a considerable falling away from the original duty of 70 to 80 candle power. While we cannot speak from experience with petrol air gas, we can with incandescent mantles using coal gas; and mantles that have been in use some ten months daily are not with coal gas, under similar conditions of consumption and pressure, showing a quarter of the falling away in duty indicated for petrol air-gas mantles. The tests that Mr. Scott-Snell alludes to were made with naked mantles; but he does not give figures as to consumption. Another rather slipshod submission is that "the light obtained from different fuels "is proportional to their calorific value." There, again, if Mr. Scott-Snell had studied coal gas of the same calorific values but of different compositions, and had noticed how the means of use affect—between 20 and 60 candles per cubic foot of the same gas—the light duty realized with mantles, he would have qualified the statement. It might also be suggested that a few spectroscopic tests of the light from petrol air-gas burners, in comparison with that from coal gas incandescent burners operating at different pressures, would be enlightening, and enable somewhat more definite information to be given as to the relative colours of the lights. There are omissions in both papers; but the generalizations in Mr. Scott-Snell's contribution project rather forcibly upon one's notice. It would be well perhaps if he took advantage of any opportunities that may offer to become a little more closely acquainted with the facts relating to modern coal-gas lighting.

Both authors were rather weak on the subject of costs. Mr. Hoddle, on the assumption of an efficiency of 40-candle power per cubic foot of gas, and with carbide at 13s. 6d. per cwt., put the cost of acetylene lighting at 7d. per 1000 candle-hours. Mr. Scott-Snell, with petrol at the present price, places the cost of 1000-candle-hours using petrol air gas at from 3d. to 4d. These cost figures are much too general; and the readers of the papers are left to much guesswork or to ferreting about to ascertain precisely what is covered by them. Mr. Hoddle does not appear to have allowed anything for the delivery of the acetylene to those country places where it would be used for mansion lighting; nor do we trace anything for purification, attendance, interest on plant, depreciation, and so forth. Much the same remarks would apply (although not in every respect) to Mr. Scott-Snell's figures. They are inconclusive; and the information they do not convey is that which is required to place comparison on all-fours with town gas lighting. However, both acetylene and petrol air-gas lighting have their limitations; and the costs quoted (apparently reduced to the lowest point by the omission of incidental expenses) show that, without any other considerations, coal gas for lighting purposes would have to be very expensive indeed before there could be any real competition with it by the two agents dealt with in the papers.

A Faulty Illuminating-Power Case.

While illuminating power is the standard quality of a gas supply, it is the duty of gas manufacturers to see that the standard is maintained, or, if they do not regard illuminating power as having any value to-day, it is their duty to take steps to place themselves under a standard that is of value to their customers. But it is, on the other hand, the duty of those whose function it is to see that the standard of quality is complied with to—before taking such a step as summoning the suppliers for a deficiency, and attempting to bring upon them the ignominy of having cheated the public (which is worse than a fine)—ascertain definitely that there has been nothing about the manner of making the test that would vitiate the result. The Skegness Council the other day hauled the Gas Company before a Bench of Magistrates, on tests showing an average result of 12·2 candles using the "London" No. 1 argand. Had the "Metropolitan" No. 2 burner been the statutory one, the prescribed illuminating power, even under the conditions that existed, would probably have been exceeded. The jet photometers in use on the day of the tests indicated an illuminating power of between 15 and 16 candles. The proceedings revealed the fact that the photometer was a new one, and had only been connected up to the town main the very day the tests were made; and the water in the meter, too, was quite fresh. There were the conditions there for a vitiated test until the use of the apparatus had produced that adjustment between the photometer and the gas supply which would credit the latter with its full value. The evidence that Mr. Percy R. Simner was able to call on behalf of the Gas Company made this clear to the Bench, who felt that they could not possibly convict after hearing the testimony of Mr. E. J. Brockway, Mr. R. G. Shadbolt, and Mr. Jacques Abady. The day the tests were made appears to have

been the first on which the Council had actually put into force their supervising authority. It is a pity that at the initial stage trouble should have occurred; it is a greater pity that before action was taken there was not a full investigation to ascertain whether there was any flaw in the case by which it was sought to bring the Company to book.

The Gas Worker and the Electrical Man.

The men engaged in and about gas undertakings have much to be thankful for in that gas can be stored, and that the simplicity of the gas distributing plant give a large immunity from trouble and emergency calls. One result of this is that the workers can have their day of rest and their hours daily from work without having their peace disturbed by a peremptory demand for their services. Their lot is distinctly better than that of their fellows of the electricity station. The plaint of an electrical man appeared the other day in the "Daily Express;" the letter being signed "Christmas Day in the Works." He states that the engineers-in-charge, engine drivers, and stokers employed in the numerous electric generating stations owned by municipal bodies and private companies have every third Sunday free, but extra time has to be worked on the other two Sundays to compensate for this. Christmas Day, Good Friday, and all other public holidays do not exist as such for them; the only holidays they get being fourteen days annually allowed to the engineers-in-charge, and seven days to the drivers and stokers. But in many cases the latter have to suffer loss of pay while on leave. He urges that now that the policeman is to have his one day's rest in seven and the tireless newspaper man to enjoy his Christmas at home, something might be done, in the case of the municipal generating stations at least, to enable the men to have a weekly day of rest who spend their nights and days in the confined and heated atmosphere of the engine room and stokehold, supplying part of the public with light and the means of transit.

A Devonshire Gas-Works Purchase.

During the progress through Parliament in 1911 of a Bill under which the Sidmouth Gas and Electricity Company sought incorporation and further powers, a purchase clause was inserted, and subsequently the Urban District Council secured an Act for the purpose of acquiring the undertaking. Arbitration proceedings to determine the price to be paid were arranged; and for three days last week Mr. A. J. Ram, K.C., sat as Umpire (the Arbitrators being Sir Corbet Woodall, D.Sc., and Mr. C. C. Hutchinson, K.C.) to hear the case. The matter was then adjourned until to-day (Tuesday), when no doubt the hearing will be concluded It will be seen from the report of the case for the Company, which appears in another part of to-day's issue, that after agreed accounts had been put in by Mr. W. Cash, valuations were submitted by Mr. Henry Woodall and Mr. J. H. Brearley. Based on 28½ years' purchase, Mr. Woodall's net valuation of the undertaking came out at £49,130, while that of Mr. Brearley was £50,254—including 10 per cent. for compulsory purchase. In the course of the proceedings several interesting points were raised. On behalf of the Council, Mr. W. B. Keen, who had acted in conjunction with Mr. Cash in preparing the accounts, was the first witness; and he was followed by Mr. E. H. Stevenson and Mr. Frank Jones, who put in valuations based on 20 years' purchase —the net figure being £27,270.

Employers' Parliamentary Association.

One must conclude that the first year of life of the Employers' Parliamentary Association has been an eminently successful one, for, when presiding at the annual meeting some days ago, Sir Charles Macara expressed the opinion that it would be hard in the records of industrial movements to find an organization in existence less than twelve months, and carried on under like great difficulties, which had attained such dimensions and such influence as that Association had done. It is more than likely that he is right in his surmise that this success is partly explained by the fact that leaders of industry are realizing more every day the imperative necessity for protecting industrial interests against hastily conceived or ill-advised legislation, "often influenced, if not entirely governed, by considerations of Party politics." Immediately on coming into being, the Association found itself confronted with a big task in tackling the National Insurance Bill. What could be done was done before the measure passed into law. But activity is not to cease now that the Bill has become an Act. On the contrary, in the opinion of the members of the Association, a closer acquaintance with the provisions only serves to still further emphasize the need for alteration. Therefore, determined and sustained action has been resolved upon, until such time as the amendments considered necessary shall have become law. An Association of this character—altogether outside Party politics—should be able to accomplish much good; and those whom the movement is likely to concern, may have their attention drawn to a declaration by the Chairman that one of the aims of the Association is to endeavour to induce all the organizations of employers to act together.

THE DESSAU VERTICAL-RETORT PATENTS.

The Litigation in Germany.

Since the receipt of the information on which a paragraph on this subject appeared in last week's "JOURNAL" (p. 85), some few particulars are to hand from Germany as to how the High Court at Leipzig defined the protection they granted to Dr. Bueb's patents in the suit instituted against Messrs. Pintsch, of Berlin. The Judges held that the chief characteristics of Dr. Bueb's process are the production of a thin tar and a gas poor in naphthalene made in vertical retorts which are completely filled with coal, have no outlet for tar at the bottom, and which moreover are exposed to a temperature exceeding the one generally in use (with horizontal and inclined retorts) at the time when the patent was taken out. The Court furthermore stated that vertical retort-settings by which thin tar and gas poor in naphthalene were produced were not in use in the gas industry before patent No. 167,367 was applied for.

A communication on the matter has been made to the German technical press by Messrs. Pintsch in the following terms:

As is already known, a plea of nullity was entered about two years ago by Messrs. Julius Pintsch, of Berlin, and Gustav Horn, of Brunswick, against the process patent No. 167,367, of the Dessau Vertical Retort Syndicate. In the first instance, this plea was successful; the Patent Office declaring the patent to be annulled. Nevertheless, the Imperal Court disallowed this judgment as the result of a hearing on Jan. 11, 1913, and reinstated the patent in conformity with its original scope. The decision, however, of the Imperial Court is of no actual importance to Messrs. Pintsch, seeing that, in the past year, there has been, between the said firm and the Dessau Syndicate, a recognition whereby the matter has been settled for Messrs. Pintsch. The recognition states that the firm are entitled to construct vertical retort-settings of their own design (partly protected by patents) for commercial purposes, and to bring the settings into use, with protection to the users without the further consent of the Dessau Syndicate. It is further remarked that in Austria the "ascertaining action" has been decided in favour of Messrs. Pintsch, and in Hungary the patent of the Dessau Syndicate has been finally destroyed.

A further communication to hand explains that the "recognition decision" was issued in connection with an application for the collection of evidence, deposited formerly at the Royal Supreme Court on Jan. 30, 1912. It secures to Messrs. Pintsch the building of vertical furnaces; the judgment running as follows: (I.) Regarding the action: (1) It is established that the plaintiff is entitled to construct vertical settings for commercial purposes, to bring them into circulation, to sell or use them, if the upper heated part of the vertical retorts contains no coal for about ½ m. high, and that this part is heated to a temperature of at least 700° C. (2) It is established that the buyers of the vertical settings described under No. 1 may use these settings without the consent of the plaintiffs. (II.) Regarding the counter-action: It is established that the plaintiffs are not entitled, during the life of patent No. 167,367, to construct, offer for sale, or use, such vertical settings as have: (*a*) The retort fully charged with coal, as far as it is heated, and if simultaneously the retorts are heated above the temperature otherwise customary in July, 1903; *or* (*b*) the upper combustion chamber empty to the height of about ½ m., but a temperature under 700° C. on the walls; *or* (*c*) the upper part mentioned in division *b* filled with a material other than coal, but having a temperature of below 700° C. on the walls. This decision is in force at the present time. The suit of nullity entered by Messrs. Pintsch, it is further stated, was commenced by them only for the support of the previous application for the collection of evidence.

Gaslight and Coke Company's Dividend.

We are informed by the Secretary of the Gaslight and Coke Company (Mr. Henry Rayner) that the accounts for the past half year show that (subject to audit) the balance to the credit of the net revenue account will enable the Directors to recommend the payment of a dividend at the rate of £4 17s. 4d. per cent. per annum; carrying forward to the next account the sum of £712,387 4s. 10d. This time last year, the dividend was at the rate of £4 14s. 8d. per cent., and the amount carried forward was £726,747 13s. 10d.

ELECTRICITY SUPPLY MEMORANDA.

It would be, in our unbiassed opinion, a matter of great difficulty to place the "Electrical Review" in any single class among the weekly output of literature of the country. It claims classification among "technical" and "trade" papers; there have been times when certain matters have appeared in it which would assist in substantiating (as we have had an opportunity of showing on various occasions) a claim to position among the "comics;" and —— we were about to suggest a further class, but will refrain for the sake of peace and quietness. In its issue of a week or so ago, it was stated that "the 'Journal of Gas Lighting' is greatly chagrined to discover that the Board of Trade will have nothing to do with obsolete systems of lighting (such as gas) when it can obtain electric light." The "obsolete systems of lighting (such as gas)" is truly funny; and it ranks with various other—probably unwittingly—humorous things that have appeared in the columns of our contemporary. If the Editors of the "Review" really believe that gas lighting is obsolete, they must have been walking about in a state of stupefaction, or with eyes absolutely closed, or perhaps their perambulations have been very circumscribed, and have only taken in a few of the comparatively small hot-beds of electric lighting. What we find, by taking a long-range view, is that people are getting more and more a correct idea of the relative qualities of gas and electric lighting, and are adopting the latest types of the former with increased vigour. The attention of the "Review" may be directed to an article in other columns describing facts and impressions gathered the other night on a tour of South London. The Editors of our contemporary will find something there on which to meditate. There is nothing clever in false description; on the contrary, its foolishness is quite apparent to those electricians who come to close quarters with the competition of modern—not obsolete—gas lighting, and know of many electric arc and other electric lamps that have fallen before the large change of favour from electricity to gas.

Envy, Malice, and Uncharitableness.

The Rival of "Obsolete" Gas.

"When it can obtain electric light." Of course, the Board of Trade like other users cannot always obtain the current for keeping electric lights going. This is one of the bad qualities of electricity supply which have caused not a few electricity consumers to reinstate gas lighting. In an editorial article in the same issue of the "Review" in which the silly reference to gas appears, we read that many central station engineers "would barter their souls to ensure continuity of supply; and it is therefore not difficult to estimate their feelings in the matter." It shows a precious bad condition of things, when men would barter their souls to gain a single object of that sort. What shall it profit a central station engineer if he shall gain the whole world and shall lose his own soul? The "Electrical Review" perhaps can answer the pertinent inquiry. But even this contemporary in its ignorance (taking a generous view of its absurd description of gas lighting) of what is happening commercially and technically in connection with gas, realizes that electricity is not indispensable. For some purposes—such as for traction—it is; but for "a great many of its applications the advantages which have served to popularize its use are not such as to entirely outweigh a general (even though unjustified) impression of unreliability gathered from reading the daily newspapers." Again we say our contemporary is really very funny. Why interpolate the "even though unjustified?" The justification has about it a splendid substance—such substance that many central station engineers would "barter their souls to ensure continuity of supply." Moreover, "it is for the central station engineer to appraise the pecuniary value of reliability. Our own impression is that any means which will ensure that public lighting, for instance, is not wholly dependent on the perfection of the mechanical, electrical, and human agencies at the power station, is well worth paying handsomely for." The editorial paragraph from which we take these passages is headed "The Fire Risk!" If gas lighting is an "obsolete" system, what would the Editors of the "Electrical Review" call the system about which they are writing. They should not allow the walls of the editorial rooms on Ludgate Hill to limit their view of the affairs of the outer world in any one particular. It would be far better to get into more intimate contact with those men who know the truth by that best teacher of all—experience, and then write facts concerning gas lighting, and the position generally of gas, as a competitor of electricity.

Competition and Indications.

The same lines of reasoning and narrowness of view are seen in another paragraph in the "Review." It is known that the York City Council have in Parliament this year a Bill for the purchase of the York Gas Company's works. We are anything but pro-municipalizers. The York Gas Company and the Council having, however, come to an agreement in regard to transfer, and the city being desirous of obtaining possession notwithstanding its ownership of the electricity concern, if Parliament endorses the scheme, our duty will not be of an antagonistic order under the new *régime*. It appears that the Chairman, Vice-Chairman, and other members of the Electricity Committee are leading advocates in this purchase; and that is pure heresy in the sight of the "Review." It is pretty evident that our contemporary sees danger in the project for the electricity undertaking. Surely, there cannot be the remotest danger if gas lighting is an "obsolete" system. There is just a chance, however, that the members of the Electricity Committee referred to are wiser in their day than their electrical critic. They know the various facts of the case; the "Review" evidently does not. It admits that it "cannot pretend to understand the reason for their attitude, as the electricity supply department will be the loser by the stifling of competition which naturally follows when both electric and gas supplies are controlled by the corporation." That is a general indictment of the dual control that has no general foundation in fact. For answer, look at the volume of the business of both departments in Birmingham, Manchester, Leeds, Glasgow, and Edinburgh. Competition is good; but we have not yet found any very substantial evidence of any great harm arising directly from the suggested "stifling" where the two undertakings are under municipal control. There are other defects of municipal control within our ken which are not liked, but they take us to wider fields of controversy than this particular point of competition. The York City Council have a reason, and a very good one, for wanting to possess the lucrative gas undertaking; their only sorrow is they did not become owners of it at an earlier date, before it reached its present magnitude. The "Review" also seems to hint at the approach of the day when the gas industry is electrically supposed to be fated to collapse like a pack of cards. It says that there is every indication that the price of electricity can, and will, be greatly reduced in the near future, and that the prospects of competing gas undertakings will be correspondingly affected—this being already apparent in some localities." Will the "Review" kindly enlighten us as to which localities it refers to? Optimism and imaginings can be carried to such a length as to impair the mental balance; and for auld acquaintance' sake, our contemporary may be advised to put on the brake while there is time. It could, if it willed, name some electricity undertakings that have found the average price of their supply undergoing the process of automatic reduction to such a very fine point that their administrators have, as the outcome, had to retrace their steps, and actually raise the price. That is another "indication;" so that "*every*" indication is not in the other direction.

More as to the Rival.

It has been seen that the rival of "obsolete" gas is not without its failings. On the same and next pages of the "Review," we observe the human toll of electricity supply extended by four more deaths; and turning to a provincial paper we read an account of great excitement in Sheffield on Jan. 12 due to a falling telephone wire which came in contact with a live tramway wire. The fallen wire became buried in the snow, which is said to have become "charged" by electricity. Two horses were electrocuted, and men were struck down, and shrieked with pain and fear. The would-be rescuers of the men who first fell were severely injured, and had to be detained in the infirmary. It is only right that the faults of unreliability and danger of electricity should be made public, as though the cultivation of trade in electricity supply under false pretences is not unknown, the better type of men in the rival industry would prefer that the public should be informed as to the actual condition of things. Such persons will be obliged to the writer of the article on "Health and Hospitals" in the "Daily Telegraph" for telling the readers of that influential organ the other day something about what to do in case of electrical shock. The first thing is to try to get the stricken person to breathe again as quickly as possible; seeing that the shock paralyzes the action of the organs of respiration for the time being, and not infrequently the heart also. There are other facts included in the article which warn the public that the electricity supplied to the household will not allow itself to be played with. Recent occurrences have been further impressing this fact on the public mind. The writer states that the current taken into dwelling-houses is powerful—it is powerful for harm. A householder may fearlessly tinker with his electric light, so long as he only comes into contact with one wire; but if he at the same time touches a "return" and finds himself in the direct path of the current, he will be lucky to escape a serious shock. Under ordinary circumstances, it is not likely that a shock received from a plug or electric-light bracket in a private house will be fatal, although the reception of the full current from this source usually causes faintness and very severe nervous disturbance. Expectation, as Professor Jellinek was saying recently, greatly minimizes the effects of shock. Reference is also made to the deaths in West-end baths, and to the case of a boy who, through a toy electrical appliance, caused his own death in the bath in his father's house. The rival of "obsolete" gas lighting has also a further adverse testimonial in a brief report published by "Electrical Engineering" of an informal paper by Mr. E. Handcock at a meeting of the Dublin Section of the Institution of Electrical Engineers. The paper was on the "Metal Filament Lamp in Relation to the Eye." There was no question as to the author's views regarding the distressing and harmful effect on the eyes of these lights of high intrinsic brilliancy. The speakers in the discussion concurred; and one of them, protesting against the use of naked metallic filaments in shop windows, went so far as to say

that he considered shopkeepers offending passers-by in this respect should be liable to prosecution for nuisance. He is not wrong.

Prophets and Profits.

Intermittently there comes along the advocate for developing electricity supply in villages. This is a result of the necessity for finding fresh work for professional advisers and electrical contractors. One paper tells us that there are thousands of villages anxiously waiting for a supply of current; and that there is good and profitable business to be done in this direction, more especially now that the metallic filament lamp is here. The metallic filament lamp rather reduces the chances of distributed current in villages, on account of the smaller consumption not being compensated by (in such places) larger use. It seems to be forgotten by those who are agitating this matter, that the bulk of the populations of villages are the poorest of the poor, that the hours of their use of lighting agents are fewer than in towns, and that of shops there are not many; and therefore that the field for development of this kind is not an extensive one. If villages were waiting so anxiously for a supply, the residents should take steps to provide it; but in such matters as this, they are often the victims of company promoters and others. There are a number of small electricity undertakings in the country that have never paid their way; and it is not very hopeful that they ever will. At the same time, we are perfectly aware that it is possible now to put down a modest electricity generating plant that will produce current cheaper than some of the smaller public installations are doing at the present time. We know of private gas-driven plants giving energy for all purposes at local power prices, even in London; but these have no distribution or certain other of the expenses which a public supply undertaking has to bear. The advocates of the village schemes, we are afraid, take a very roseate view of the financial prospects of these schemes. We see that in "The Times" a hypothetical scheme is submitted with a capital expenditure of only £1370, on which a profit of 29 per cent. is calculated. Why give away such a gold mine? Towns that are thickly populated, with many more consumers per mile of cable than it will be possible to secure in villages, are asking themselves, "If this be true, why do our electrical undertakings show up so badly in comparison?" Ratepayers who have had to contribute many thousands to the support of their electricity concerns, will wish their authorities had not been so premature, but had waited until these prophets of profits from almost barren villages had come along to show how the thing could be done.

Penny Per Unit.

In last week's issue (p. 83), the decision of the Lowestoft Corporation to charge 1d. per unit for current used for cooking was utilized, by way of example, to see whether anyone would come forward and justify, by the principles applying to electricity tariffs, such a charge for cooking purposes. Since then the annual accounts have been before the Council; and we see there has been a loss of about £57 on the year, after taking into account a deficiency of £242 on the cottage business. There was great complaint about the shorter loan periods for certain subjects now allowed by the Local Government Board. There were also regrets that the wet summer had interfered with consumption. The cost of coal, too, has increased by 2s. 9d. per ton; and the prices of materials generally have gone up some 25 per cent. The Chairman also said that it was quite impossible to make a reduction from the 1¾d. per unit charged for tram traction. Having regard to these matters, the prospect of a good case of justification being forthcoming for the charge of 1d. per unit for cooking appears more remote than ever. Possibly, however, the Electricity Committee do not anticipate any serious accretion of business from cooking at 1d. per unit. If they did, the Tramways Committee would probably insist on them disclosing the reasons why they propose supplying for such an intermittent load as cooking at 1d., while for traction purposes the charge is 1¾d. The wisdom of some of the items in electrical tariffs requires a lot of explanation. The only discernible justification—if justification it can be called—is that 1d. per unit is the fashion. But fashion and business are not, in this instance, synonymous terms. Reverting to the reference made to Lowestoft last week, we believe it is due to the Electricity Department that it should be stated that the charge for lighting purposes is 4½d. per unit.

Obiter Dicta.

Mr. D. S. Munro is the author of a book on "The Practice of Electric Wiring," about which some good things have been said. There is some plain speaking in the book. Here are three or four examples: "A large proportion of the flexible on the market is of very poor quality, and is well into the process of decay before it leaves the works of the maker. . . . Much of the bad flexible is made on the Continent for our special consumption." "The competition of gas, indifference to electrical risks, inadequate specifications, lax rules and inspectors, and the public worship of the lowest tender, have combined to cut the cost of wiring to an unstable limit." "On the whole, the system [surface flexible wiring] cannot be recommended. Although the cost is low, the life is short. It cannot be relied upon for more than five years, and only then if no repapering or lime-washing has taken place in the interval." "There is much rubbish sold under the name of steel conduit; and it behoves the contractor to examine carefully what he is buying." But it seems that there are contractors who do not trouble much.

GAS BILLS FOR 1913.

[Third Article.]

In this article we complete the review of the additional power projects of Statutory Gas Companies which will be submitted to Parliament in the ensuing session.

The Bill of the Slough Gas Company is primarily for the consolidation and conversion of the capital; but brought into the measure are a large number of powers of modern form. The present capital comprises £5000 created under the Company's Act of 1866, consisting of 500 ordinary shares of £10 each, and entitled to a dividend of 10 per cent. per annum; £19,570 raised under the Company's Act of 1866 by the creation and issue of 1957 shares of £10 each, entitled to a dividend of 7 per cent. per annum; £17,780, raised under the Company's Order of 1901 by the creation and issue of 1778 shares of £10 each, also entitled to a dividend of 7 per cent. per annum; and £430 under the Company's Act of 1866 by the creation and issue of 43 preference shares of £10 each, entitled to a dividend of 6 per cent. per annum. The balance of the capital authorized by the Order of 1901, and remaining to be issued is £1632. Premiums were paid upon the additional capital created under the Order of 1901 to the amount of £5587. By the Act of 1866, the Company were authorized to borrow on mortgage £6250; and by the Order of 1901 a further sum of £6250. They have borrowed £8300, entitled to interest at the rate of 4 per cent. per annum; leaving unexercised borrowing powers to the amount of £3792 in respect of the capital already issued, and a further £4200 when the whole of the capital of £50,000 shall have been issued and paid up. The proposal is to convert the capital into a stock bearing a dividend of 5 per cent. per annum. The existing preference shares will be converted into an amount of £516 preference stock, bearing 5 per cent. per annum, and the ordinary shares into an amount of £62,290 of 5 per cent. ordinary stock. For every 10 per cent. £10 share the holders will receive £20 nominal value of stock, and for every 7 per cent. £10 share £14 of stock. The unexercised capital powers, it is proposed, shall be continued. Additional capital powers to the amount of £50,000 are now sought. Then beyond their existing authority, the Company desire permission to borrow a sum equal to one-third part of the additional issued capital. The Directors ask for power, if they think fit, to appropriate out of revenue in any half year a sum of £60 to a fund to be called the capital redemption fund. This money is to be devoted to the buying and extinguishing of stock. The power, however, is only to come into operation in the event of the Company ceasing to use for the purpose of the business, or otherwise abandoning, their works in Chandos Street; and it is to cease to operate as soon as they shall have appropriated and applied sums amounting in the aggregate to £2000. The promoters ask for an extension of the limits of supply to include the portion of the parish of Burnham which does not form part of the limits of supply of the Maidenhead Gas Company, and a defined part of the parishes of Langley Marish and Horton. Provision is made for extinguishing any rights of the Uxbridge Gas Company in the specified portions of these parishes. The Company propose that the prescribed illuminating power of the gas shall be 14 candles. They also request that they shall not be subject to penalty for neglecting or refusing to furnish gas to anyone using suction-gas plant so long as the giving of such supply would interfere with the supply for public or private lighting in the case of persons not using such plant. A stand-by clause referring to gas only appears. A standard price of gas, other than in Datchet and Burnham, and the parts of Farnham Royal and Stoke Poges not included in the Slough urban district, is proposed at 4s. 5d. per 1000 cubic feet, and within the parishes of Datchet and Burnham and the parts of Farnham Royal and Stoke Poges 4s. 8d.; but the difference in price between the latter and the urban district is never to exceed 3d. per 1000 cubic feet. The sliding-scale will operate in respect of dividend by variations of 2s. 6d. per cent. [*Parliamentary Agents: Messrs. Crowders, Vizard, Oldham, and Co.*]

By the Act obtained in 1901, the South Staffordshire Mond Gas (Power and Heating) Company were authorized to supply producer gas in South Staffordshire and East Worcestershire. A capital of £1,000,000 was then authorized; and of this £330,500 has been paid up, £522 surrendered, and £530 cancelled. There remains to be issued £668,448. The one-third borrowing power has been exercised to the nominal amount of £93,250, entitled to interest at the rate of 5 per cent. per annum. The Company now say that the demand for gas is increasing; and further capital expenditure is needed. They are in the position of having paid the interest due on the debenture stock, but only one dividend at the rate of 1 per cent. in respect of the year 1911 on the ordinary shares. In consequence of this, no moneys can at the present time be raised by them by way of their unissued share capital, which may not be issued at a price below par. No power was conferred upon the Company in 1901 to raise money by the creation and issue of preference shares; and they therefore now ask that such power should be granted in respect of one-half of the authorized capital. They also desire power to purchase or redeem by agreement all or any part of the issued debenture stock, or, by agreement, to substitute therefor preference shares. It is contemplated that an agreement dated Jan. 11, 1901, shall be read and construed as if the shares to be issued to Ludwig Mond, his executors, or administrators, were ordinary shares, and the words

"whether preference or ordinary shares," it is suggested, shall be inserted in the agreement for the purpose of so construing it. The Company are also taking power to establish a co-partnership scheme; and authority is likewise requested to the formation of a benefit fund for servants, by the appropriation out of revenue of any sum not exceeding one-twentieth part of the profit shown by the revenue account in any one year, providing that the fund shall not exceed the sum the Directors would have been entitled to so appropriate during the preceding five years. The promoters include a stand-by clause, which, under their special circumstances, referring to power and heating gas, is varied from the forms usually adopted in measures referring to town gas supply. It runs as follows:

(1) Notwithstanding anything contained in the Act of 1901 or any other Act, no person shall be entitled to demand from the Company a supply, or the continuance of a supply, of gas for premises on which gas or electricity is generated, or on which a separate supply either of gas or electricity is used (otherwise than solely for the purposes of illumination)—that is to say, a supply from an installation other than that of the Company on or for premises on which furnaces, machinery, or apparatus are, or is, used for making gas or utilizing gas not supplied by the Company, except upon such terms and conditions (including price) as may be from time to time agreed upon in writing between such person and the Company.

(2) Notwithstanding anything contained in any enactment to the contrary, the Company shall not be obliged to give, or to continue to give, a supply or increase of supply in cases where the same is required suddenly or for short or intermittent periods, if the affording or continuing such supply would, in the opinion of the Company, interfere with or jeopardize, the Company's general supply within the district.

(3) Nothing in this section shall be deemed to entitle the Company during the continuance of any contract existing at the date of the passing of this Act to decline to give, or to continue to give, any supply which the Company may be bound to give, or to continue to give, thereunder.

There is nothing of special character about the other clauses. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

We are inclined to view the Tottenham Gas Bill as the gas measure of the session. The chief points about it are the schemes for taking over the Enfield Gas Company's works, and for obtaining powers to supply electricity in part of the district. The issued capital of the Enfield Company amounts to £137,280 of consolidated ordinary stock, and £26,325 of consolidated preference stock. The standard dividend on Enfield ordinary stock is 5 per cent.; and the standard price of gas 4s. 6d. per 1000 cubic feet. The price of gas is now 3s. 1d. per 1000 cubic feet. Debenture stock has been issued to the nominal amount of £25,000, bearing interest at the rate of 4 per cent. per annum, and to the amount of £5500 bearing interest at the rate of 5 per cent. An agreement has been entered into for the transfer of the undertaking, under which each holder of consolidated ordinary stock will receive, for each £100 held by him, the sum of £105 of "B" consolidated ordinary stock; and the holders of preference stock will receive £100 of preference 5 per cent. stock for every £100 held. The holders of 5 per cent. Enfield debenture stock will receive £125 of 4 per cent. Tottenham debenture stock; and the holders of 4 per cent. Enfield debenture stock will receive an equivalent sum of 4 per cent. Tottenham debenture stock. The promoters ask for authority to exercise all the powers applying to the Tottenham Company in the Enfield district, and to preserve certain of the powers of the Enfield Company. The latter are entitled to raise £102,800 by the creation and issue of consolidated ordinary or preference stock, and this power it is proposed shall be transferred. The promoting Company ask that their borrowing powers may be on the lines of one-third part of the total issued capital. One of the Directors of the Enfield Company is to become a Director of the Tottenham Company. Then the first vacancy that occurs on the Board otherwise than by rotation is not to be filled up, unless the first vacancy shall be caused by the death or resignation of the Enfield Director. The Enfield Director who becomes a Director of the Tottenham Company is not to receive any fees during the period of two years from the date of transfer—save reasonable travelling and other expenses incurred in connection with his duties as a Director. Within one month from the date of transfer, each Director of the Enfield Company is to receive a sum equivalent to eight years' purchase of his annual remuneration (with income-tax thereon) of his office, calculated on the average of the three years immediately preceding the date of transfer. Each Auditor is to receive £189. Compensation to officers is provided for, as well as the continuation of pensions. In respect of any portions of the area supplied by the Enfield Gas Company over which the Barnet, Colney Hatch, and Southgate District Companies have power, those powers, it is proposed, shall cease. The price of gas in the Enfield district, it is contemplated, shall not exceed the Tottenham price by more than 8d. until the end of 1916, by not more than 5d. until the end of 1918, and by not more than 2d. until the end of 1920. Thereafter, the price will become uniform with Tottenham. The promoting Company submit a change of title, from Jan. 1, 1914, to the Tottenham District Light, Heat, and Power Company. The next clauses deal with the proposed transfer to the Company of the Wood Green District Council Electric Lighting Order. Land is scheduled for a generating-station at Wood Green. The Company are, within one month after the date of the passing of the Act, to pay the Council the sum of £500 towards the expenses of obtaining their Electric Lighting Order of 1902. Purchase powers, operative at specified dates, are conferred upon the District Council; and the Company ask for the right to effect, by agreement, transfers to them of other electricity undertakings. The sliding-scale powers are to be altered so as to apply half-yearly; and this will cause the substitution of 1s. 3d. for 2s. 6d. in the existing clause of the Company's Act of 1898. In a clause, the marginal note of which is "Dividends on Preference Capital," it is proposed that the clause in the Act of 1898 as to the limitation of the profits shall be amended, so that the words "£5 in respect of every £100" appear instead of "£4 in respect of every £100." The Company seek the right of first offering new stock to consumers and employees; and power is also taken to issue stock under the co-partnership rules. It is intended that the provisions of the Act of 1906 as to "the supply of fittings," and "fittings not to be subject to distress," shall extend to any apparatus and appliance supplied under any hire-purchase agreement. A stand-by clause applying to both gas and electricity is included; and the Company seek relief from the obligation to give a supply from any main for any purpose other than lighting or domestic use, in any case where the capacity of the main is insufficient for such purposes, if and so long as the supply would, in the opinion of the Company, interfere with the sufficiency of the gas required to be supplied by means of such main for lighting purposes. [*Parliamentary Agents: Messrs. Lees and Co.*]

The Bill of the Tynemouth Gas Company is mainly for the purpose of extending the limits of supply, and conferring co-partnership scheme powers. The area in which the Company are empowered to supply gas is the parish of Tynemouth as defined by the Act of 1867; but the parish of Tynemouth now comprises the district of the county borough of Tynemouth and the urban district of Whitley and Monkseaton. The Company desire that their area should now be better defined. There are also the urban districts of Earsdon and Seaton Delaval without a statutory supply of gas. The Company therefore wish for an extension of their area so as to include these districts and as much of the former parish of Hartley as is now included in the urban district of Whitley and Monkseaton. It is intended that in Earsdon the price of gas shall not exceed by more than 6d. the price charged in the borough of Tynemouth and the urban district of Whitley and Monkseaton, and in Seaton Delaval the excess price is not to be more than 1s. The usual form of clauses relating to co-partnership are embraced in the Bill. Several miscellaneous clauses of modern character are inserted, including a stand-by clause. The Company ask for authority to supply power gas, subject to the clauses ordinarily applying to this business. [*Parliamentary Agents: Messrs. R. W. Cooper and Sons.*]

The Westgate and Birchington Gas Company are promoting a measure to empower them to supply electricity, and to confer upon them further capital and other authorization. By their Acts of 1881 and 1882, power was granted to the raising of £39,000 of capital and £9750 by borrowing. Nearly the whole of the share and loan capital has been raised. Coming to the clauses of the Bill, an extension of limits is sought. The standard illuminating power of the gas supplied is placed at 14 candles, tested by the modern means. A long list of clauses now usually adopted appear, among them being a gas stand-by clause. The area of electricity supply is defined as Westgate-on-Sea, Birchington Wood (otherwise Acol), and St. Nicholas-at-Wade. Land is scheduled for a generating-station. The succeeding clauses are all normal in form. The style of the Company, it is proposed, shall be changed to the Westgate and Birchington Gas and Electricity Company. The Company ask to be empowered to raise additional capital not exceeding £45,000, bearing 7 per cent. dividend on the portion of it issued as ordinary, and 6 per cent. on the part that is issued as preference. In respect of the existing capital, the Company seek authority to the borrowing of (inclusive of the £9750 already borrowed) £13,000. On the additional capital, power to borrow to the extent of the usual one-third is desired. The Company wish, further, to be invested with authority to put into force a profit-sharing scheme. [*Parliamentary Agents: Messrs. Lees and Co.*]

In the Bill promoted by the Worthing Gas Company, we have a necessary sequel to the litigation there has been relating to the interference by the Company with a private tunnel in Goring Lane. The history of the matter is briefly this: By their Act of 1907, the Company secured the right to manufacture gas at Goring. In pursuance of their powers, the Company laid mains and pipes along Goring Lane, under which they found a tunnel or building; and in order to do as little damage to it as might be, they made special arrangements in the construction and laying of the pipes. On the application of the owner of the tunnel, the High Court decided that certain parts of the pipes constructed across the tunnel had been laid by the Company into, through, or against it, in contravention of the provisions of the Gas-Works Clauses Act, 1847, and ordered the removal of those parts. In pursuance of an undertaking given during the proceedings in the High Court, a plan was submitted to the owner of the tunnel showing an altered method by which it was proposed to lay the pipes. The High Court held, in a further action brought by the owner, disputing the right of the Company to lay the pipes in accordance with the altered method, that the Company are entitled to lay them in the position shown upon the plan; but the owner, pending the decision of the Court, made such alterations and additions to the tunnel that the Company cannot now lay their pipes thereover in accordance with the plan without either interference with the tunnel or risk of fracture of the pipes. The pipes connecting the new site with the works at Worthing have been legally laid on either side of, and up to, the tunnel; and the

Company have expended a considerable sum on the work. Now the Company are in Parliament with the sole view of obtaining statutory authorization to lay mains and pipes through and across the tunnel, or any addition thereto, or alterations or reconstruction thereof, or any other structure substituted therefor, or constructed in proximity thereto. Provision is made for any compensation to the owner for any damage caused to him; but the Company ask that there shall be, in any arbitration, no award in respect of any new building or alterations made after Nov. 20, 1912, if, in the opinion of the arbitrator, such alteration was not reasonably necessary. Protection is given to the District Council of East Preston. [*Parliamentary Agents: Messrs. Dyson and Co.*]

PERSONAL.

At the meeting of the Institution of Civil Engineers last Tuesday, Mr. NEIL M'KECHNIE BARRON, Water Engineer to the Lincoln Corporation, was elected a member.

Mr. F. BOWEN, who was for twelve years Assistant Gas and Water Engineer at Leigh, has accepted an appointment as one of His Majesty's Inspectors of Factories and Workshops. Some time ago, Mr. Bowen sat for a competitive examination under the Department; and his knowledge of engineering and chemistry was a strong point in his favour. He has already commenced his new duties.

Alderman JAMES LISTER, who has been a member of the Liverpool City Council since 1895, has been compelled by failing health to retire. He was for thirty years on the Board of the Liverpool United Gas Company; but his resignation, from the above-named cause, was announced at the last half-yearly meeting of the Company, when the Chairman (Mr. H. Ward Deacon) expressed the hope of the Directors and shareholders that he would always remember with pleasure his association with them.

The Bacup Town Council recently decided to confer the freedom of the borough upon three gentlemen who have rendered special service to it. One of them was County Alderman JAMES SHUTTLEWORTH, a Director of the Rossendale Union Gas Company, who was upon the old Bacup Local Board, Chairman of the Incorporation Committee, and member of the Town Council from 1882 till 1888. He filled the position of Deputy-Mayor in 1887, was elected a member of the Lancashire County Council for Bacup in 1898, and was made an alderman in 1907.

Mr. J. W. HORNE, B.Sc. (Edin.), Assoc.Inst.C.E.—until recently Chemist and Metallurgist to Messrs. Fraser and Chalmers, Limited, of Erith and London, and the British High-Power Gas-Engine Company, Limited, of London—has joined the firm of Messrs. Murphy, Stedman, and Co., Limited, of 180, Gray's Inn Road, W.C. Mr. Horne has a wide experience of the manufacture of pig iron, &c., in Great Britain, the local characteristics and properties of various brands, and an extensive knowledge and connection with general foundry practice. In the firm which he has joined, Mr. Horne occupies the position of Technical and Consulting Director.

OBITUARY.

As we go to press, we learn with deep regret of the death, early last Sunday morning, of Mr. ROBERT DEMPSTER, of Eden Hall, Penmaenmawr. He had been seriously ill for some little time, and no hopes were entertained of his recovery. A few particulars in regard to his life will be given next week.

Sudbury recently lost a prominent public man by the death of Alderman C. E. MAULDON, which took place on the 7th inst., in his sixty-third year. He was elected a member of the Town Council in 1879, and remained upon it till 1894, when he was raised to the aldermanic bench. He was a regular attendant at all the Council and Committee meetings throughout his career, and was for many years Chairman of the Water Committee. He was Mayor in 1892-3, and also in 1905.

We learn from Mr. A. Morton Fyffe, the Gas Engineer and Manager of the Nelson Corporation, that the death occurred on Monday last week, at the early age of twenty-six, of his Chief Assistant, Mr. HAROLD WOODWARD. He was attending to his duties on the previous Tuesday, and next day was attacked by pneumonia. Mr. Fyffe says deceased was a young man who gave great promise of a bright future, and was very highly trained as a gas engineer—just the type of gas engineer required; and his early death is a loss not only to the Nelson Gas Department, but to the profession at large.

We learn with regret of the death, on Sunday, the 12th inst., of Mr. ARTHUR W. ONSLOW. Deceased was formerly Manager of the gas factory at Woolwich Arsenal, where, it may be remembered, he did a great deal of work in connection with high-pressure gas. He read a paper on "High-Pressure Gas for Manufacturing Purposes" at the last meeting of the Institution of Gas Engineers, of which he was a member, as well as of the Southern District Association of Gas Managers, before whom, some twelve years ago, he read two papers on "High-Pressure Lighting." In the domain of lighting, he will be remembered by the burner bearing his name.

REVISED GERMAN EDITION OF LUNGE AND KÖHLER ON COAL TAR AND AMMONIA.*

A REVISED edition of the standard work of Dr. Lunge and Dr. Köhler on "Coal Tar and Ammonia" is very welcome, especially as twelve years have passed since the previous German edition left the press. It is true that an English edition, embodying some additions, has appeared in the *interim;* but exhaustive revision is extended only to each successive German edition. The English editions are based on the immediately preceding German edition, after a more than sufficient interval for the mere labour of translation. Hence, those who are able to read German have the advantage of studying the latest work of Lunge and Köhler on "Coal Tar and Ammonia" at an appreciably earlier date than their *confrères* who can only refer to the English editions.

The fifth German edition, which is now before us, embodies much new matter; and in order that the latest available statistics shall be included, an appendix has been attached to each volume giving information collected too late for insertion in its proper place in the text. These appendices were not closed until June last; so that the work may fairly claim to have been brought down to the latest date prior to publication to which it would be possible to revise volumes of this magnitude. A marked feature of the present edition is the greater completeness of the statistical information as to the production of tar, tar products, ammonia, &c., from different sources and in different countries. In some directions, however, the statistics in regard to English works are curiously scrappy, and occasionally not brought down to the latest date. This seems to be due to their having been obtained indirectly—*e.g.*, figures from the Board of Trade returns of gas undertakings never appear to be given from the returns themselves, but from writings in which they have been quoted for some years and not for others. We think that, in regard to English statistics and general information as to what is actually transpiring in the tar and ammonia industries of this country, the authors would do well to secure the assistance of a competent collaborateur, resident here and engaged in the industries, to furnish them with trustworthy particulars for the next edition of their work. We do not mean to imply that English sources of information have been neglected by the authors, but merely that the information taken from them is not so well-balanced, authoritative, and complete as is that given in regard to the tar and ammonia industries in Germany.

It is unnecessary to refer in detail to the contents of the volumes, the scope of which is well known to those who are at all closely connected with the industries to which they refer. Various faults of earlier editions have been amended; but there are still too many references to obviously impracticable processes, which have merely achieved publicity through the medium of patent specifications. We think the authors should take more seriously to heart the knowledge that the majority of the readers of a work of the calibre of this one are busy men, who can ill-afford to waste time reading about schemes which no technical man would listen to for a moment. The readers have a right to expect that the authors of a standard text-book will have relieved them of the trouble of separating unmistakable chaff from grain. The discrimination between the bad and good qualities of the grain affords sufficient exercise for the more or less well-qualified experts into whose hands alone such a text-book ordinarily comes.

The work is one which is indispensable to all who are intimately associated with the tar and ammonia industries; and it will constitute a valuable book of reference to others—*e.g.*, gas engineers—who are not engaged in tar or ammonia works, but who are indirectly interested in the products handled therein. We hope that an English translation of this revised edition may be published at an early date, and that the opportunity will then be taken to make emendations on the lines which we have indicated in our remarks above.

* "Die Industrie des Steinkohlenteers und des Ammoniaks" von Dr. Georg Lunge [formerly Professor of Technical Chemistry at the Federal Polytechnic at Zürich, Hon. Doctor of Engineering (Carlsruhe)] und Dr. Hippolyt Köhler [Manager of the Rütgerswerke-Aktiengesellschaft, Berlin]. Fifth fully revised edition. First Volume, Coal Tar, with 354 illustrations; Second Volume, Ammonia, with 163 illustrations and six plates. Brunswick: Friedr. Vieweg and Sohn, 1912.

Reference has been made from time to time in the "JOURNAL" to our American contemporary "Progressive Age." The number of the publication which has just reached us—the first for the present year—starts a new series which will embody several improvements. The name has been changed to "The Gas Age," the size of page has been reduced to the standard adopted by other technical journals, thereby affording convenience in handling and facilitating reading; the editorial space has been increased; and the contents have been divided into two departments—engineering and commercial. A special feature is a competition among writers of articles, for which prizes will be awarded. "Progressive Age," established thirty years ago, is considered to have played its part in making gas history. "The Gas Age" will profit by this experience, and proposes to "occupy the field as a very live factor in the continued development of the business." We trust the aspirations of its conductors may be fully realized.

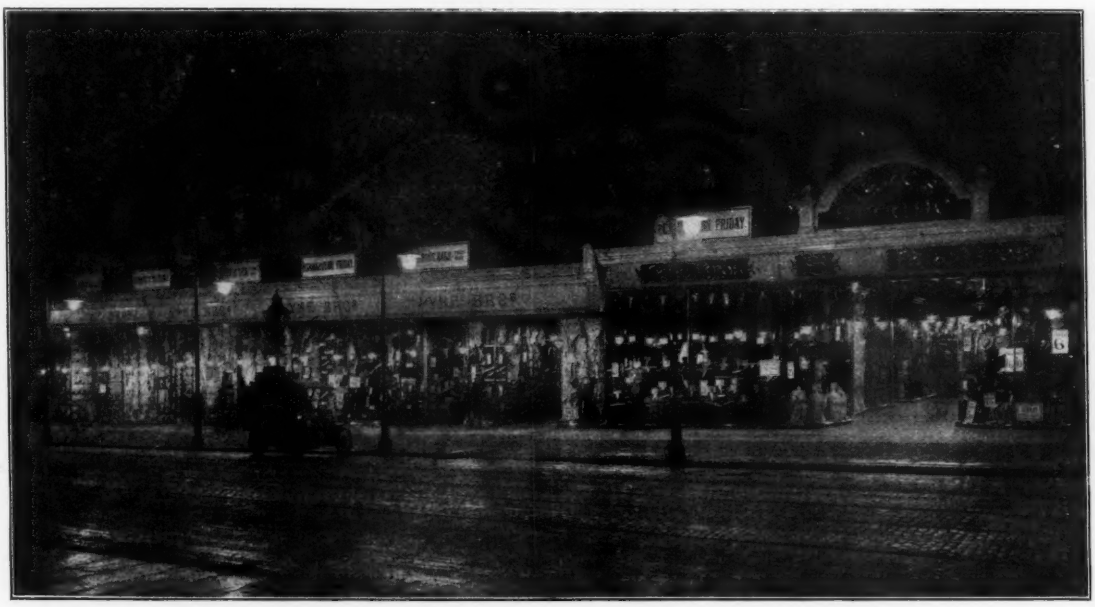
THE LIGHTS O' SOUTH LONDON.

A Forty-Mile Evening Trip through the Streets, and What was Seen.

FORTIFIED by those elements of dress that expand one's girth, but protect against the physical dangers of sharply opposing temperatures in making, on a cold January evening, a rapid flight by motorcar, the writer—a member of the "JOURNAL" staff—with a companion, set out for the purpose of surveying the lights of South London; and he was rewarded beyond anticipation. The journey ended with the formerly well-established opinion strongly reinforced that the gas industry has good reason to congratulate itself upon the position it occupies in the matter of the means by which it is enabled to effectually meet competition in the lighting field, and further upon the knowledge that is spreading everywhere among householders and shopkeepers where such a vigorous lighting policy and whole-measure enterprise prevail as is found in the district of the South Metropolitan Gas Company—a policy and an enterprise that are essential unless gas suppliers are prepared to leave the ground, unprotected by the advances of scientific gas illumination, to be gradually but surely occupied by its chief competitor.

THEN AND NOW.

Before commencing our run round a large part of the district, let us linger for a space to take a hurried look back. For thirty and more years, the writer has known this area of the South Metropolitan Gas Company. He brings well to memory the days of the ancient square-faced lantern in South London thoroughfares, with draught-admitting crannies that made the lights flicker, and the shadows of the lantern ribs to shift restlessly on the surfaces of roads and footpaths. Then, earliest in the field for facilitating reformation in street lighting by offering assistance to the local authorities, was Sir George Livesey, whose enterprise in this matter showed the instincts of a good sportsman. The incandescent gas-light had come, and had established itself; and Sir George was minded to see it throughout the streets of South London. Quickly came the change; and the graceful "Eddystone" standard, and the three-ribbed lanterns with curved panes, took the place in the main streets of the old-fashioned standards and lanterns, and, where in the side streets the older lanterns remained, they were brought into condition for the use of the vertical incandescent burner. Sir George lived to see nearly the complete supersession of the flat-flame burner by the incandescent burner throughout the extensive supply area of the Company. To-day



HIGH-PRESSURE LIGHTING AT MESSRS. PYNE BROS., LEWISHAM HIGH ROAD.

there is not a single flat-flame burner in the public ways of the Company's district, comprising as it does the territories of several Borough Councils, and, according to the last statistics in the writer's possession, 24,426 street lamps.

Still times change; and advance succeeds advance. The dual forces of inventive progress and competition will not permit supineness on the part of the gas industry if it would retain its prestige, and, what is more important, its business. If Sir George Livesey was enterprising and far-seeing in this matter of public lighting, the writer, as a ratepayer and gas consumer in the area, asks no permission to say that that enterprise and belief in the need for making the best possible use, in the Company's interests, of progress in the means of providing illumination are, if anything, accentuated in his successor in the chair of the Board of Directors, Mr. Charles Carpenter. The night-ride through some forty miles of streets confirms the general impression that had been previously formed. In the main thoroughfares, the vertical incandescent burner has been replaced by the "Metro" burner—a burner of which it may be said that, with the straight coal gas of the Company, the larger experience there is with it on the part of both local authorities and private consumers, the better it is liked. The steady uniform rays of this inverted burner—rays directed where wanted—have made a vast difference in the night illumination of roads that have been known to the writer these thirty years and more. As we sped along, defects were looked for, but not expected, though occasional ones are pardonable in a large supply area through which streams heavy traffic in many places even when London otherwise sleeps. In the whole of the forty miles, there was not a single lamp observed of which complaint could be made. This can be said conscientiously. Here the writer must congratulate the Company upon the excellence of the maintenance work. It may be further said that the roads are well lighted, taking into account the distance apart of the standards.

The lanterns are each fitted with a burner of 120-candle power, excepting those at important turnings and in central positions at cross roads. There they are in duplicate or in larger clusters. In the side roads and by-ways, the upright burner has still large use; but the conversion to the inverted form is but a matter of time when the burners will, in the ordinary course of things, claim renewal. Incidentally, it may be remarked here that, under the Company's maintenance schemes in dwellings and business premises alike, the "Metro" burner is used.

THE LARGEST HIGH-PRESSURE PARADE INSTALLATION IN A SINGLE GAS-SUPPLY AREA.

In the ordinary public street lighting, no high-pressure lamps are employed. But they are in the shopping centres; and there has been a remarkable metamorphosis there which must be seen to be fully appreciated. Words would fail to give any adequate portrayal of what is seen, and to convey what has been done. The enterprise of the Company among the shopkeepers has been on a magnificent scale. There were on Dec. 31 on the "parade" or "scale" system, no less than 3136 Keith high-pressure lamps, and something like 1000 more on isolated plants. These are remarkable figures; and the bulk of this work has been done during the past two years or so. The Company have created a desire among the shopkeepers for more light; and these business men on their part have not been slow to realize the trading advantages of more light. If the Company had not taken an active and

HIGH-PRESSURE LIGHTING AT THE NEW GRAND HALL, CAMBERWELL.

initiative part in this matter, the business would have gone over to the competitor. As it is, the contracts extend over a number of years. There can be no falling away on the part of the shopkeeper; and while the efficiency of the light is maintained at its present pitch, there will be no desire to do so. Under the present conditions, the desire is of an opposite character. The tradesmen like the steady and glistening sources of light, and the flood of soft, silvery illumination, without the excessive glare of the electric competitors. They know, too, the value of reliability. They will have the light, and the preference has caused numerous wasteful enclosed arc lamps and yellow and white flame arcs to give place for exterior shop lighting to the high-pressure gas-lamps, which also, as a rule, produce the eviction of all interior window lamps, whether gas or electric. There can be no turning back now by the Company. The high-pressure lighting is there; it holds the preferential patronage in most of the shopping centres of the supply area; and there can be no standing still in its application. The Chairman and Directors of the Company fully recognize this, and so do their executive officers. They likewise realize that the superior position occupied by the Company to-day in a dozen or so large and influential shopping centres will only put a keener edge on the efforts of the competitors to effect improvements to make for greater efficiency in the quality and steadiness of their arc lights. That is the position created by the restless evolution of things produced by the insatiable human appetite for higher efficiency in all directions.

The success of the Company among the tradesmen of the large shopping centres has shown good generalship; and, despite the sharp rivalry (we give the competitors their full due for this), the competitors must admit to-day the superior success of the Company. They must also admit it is not on price alone, but on the greater virtues of the high-pressure lights that the Company have reached the pre-eminent position in high-power lighting for shops. It has been a fair and square business fight; and the Company have won on merit. Of course, the initial expenditure on a new business of this kind means money; and so do protection and cultivation of business of any kind.

At the writer's request, Mr. Carpenter kindly had prepared for him a statement as to the number of high-pressure lights on the "parade" systems in the Company's area; and use will be made of the figures in the description of the tour of the chief parts of the district. Omitting reference to the high-pressure lamps on isolated plants, as already said there were on Dec. 31 last 3136 Keith high-pressure lamps in the Company's area on the "parade" systems. It is seen from the statement that the 1000-candle power units are the most popular. Of these, there are 1986 in all. The 1500-candle power units come next, with 571 lamps. The 500-candle power units are a close third, with 535 lamps. Of 3000-candle power units, there are 41; of 4500-candle power units, 2; and there is a 300-candle power lamp on the Peckham installation. The lamps are variously carried on standards near the kerbs of the footways, or on brackets fixed to the shop fronts. Altogether the Company have eleven compressor stations; but the time will no doubt come when there will be a linking-up of some of these. High-pressure gas lighting has come to stay.

NOTES EN ROUTE.

West Norwood.

The pause made before our tour begins has been a somewhat considerable one; but it is believed that it has not been without interest. It was a circular tour that was made according to a pre-arranged itinerary. It was quite impossible in one evening to visit all the principal shop-lighting centres in the Company's area during shop-lighting hours; but most of the main ones were inspected.

West Norwood, the latest of the Company's conquests in high-pressure "parade" lighting, was the starting-point. This has been a smart piece of work. Only three weeks or so before Christmas, Mannesmann steel tubes were being laid here. Before Christmas, the main shopping road was brilliant with its new "parade" lights. Consulting the list, it is found that there are already established, under contract, in this shopping thoroughfare, 150 1000-candle power lamps, 44 500-candle power ones; 7 1500-candle power ones—making a total of 201. The transformation in the area is wonderful. From comparative darkness to effulgency is the only description. As we pass through this main road, it is noticed that there is barely a shop in one part with outside electric lamps. Some of those that had such lamps have had them removed; and two or three cases are observed where inside window electric lights have been cleared away, and sole reliance is placed on the outside high-pressure gas-lamps. There are two or three amusing instances of the stimulating effect of high-pressure gas lighting upon our electric friends in this district. They have lost customers in the area. They have compensated for the lost consumption in a degree by placing some five or six of one of the latest patterns of flame arc-lamps outside an empty shop. In the case of one shop, where there are high-pressure lamps, the electric lamps are still alight alongside the high-pressure rivals. On the same premises they have placed some of the newer patterns of flame arc lamps which efficiently light the first-floor windows, and do little towards contributing to the illumination below. Another small shop that has hitherto boasted one flame arc lamp has two of the newer form suspended alongside the previous solitary lamp; and the three were alight as the writer passed the place. These efforts at making demonstration now look somewhat grotesque. Are the Company concerned supplying these additional lamps free? It appears much like it.

At Lewisham.

We must pass on, for there is much ground to cover. We speed along some of the arterial roads of Dulwich and Forest Hill (passing through part of the district supplied by the neighbouring South Suburban Company) on to Catford, and again into the area of the South Metropolitan Gas Company, which is quickly recognized by the reappearance of the "Metro." gas-burner in the street-lamps. The Lewisham High Street is approached; and we are soon in the midst of a scene of mixed shop lighting. In the part where entry is made, the shops are lighted in divers manners—gas predominating everywhere. There are a number of high-pressure lamps, and a large number of low-pressure high-power lamps; and in this part is found a fair sprinkling of electrically lighted shops. The car is run to the end of this portion of the street, and a perspective view is obtained. The scintillating white light of the high-pressure lamps can be easily picked out from all the rest; and the purity in quality of the light is not surpassed anywhere else in the thoroughfare. The electric lamps have not the same lustre; the electrically lighted shops between those illuminated with the high-pressure lamps as we look ahead, seem dead in comparison. It is a remarkable object-lesson. The large number of shops hereabouts with outside low-pressure gas-lamps attracted notice. The companion with his hand on the steering-wheel seemed to divine the writer's

thoughts. "They will have," he remarked, "to come to the high-pressure system soon; and the Company will have to supply their requirements." There seems little question about it. The hire-purchase system, private ownership of the lower power lamps, and their economy, at present combine to produce contentment. It is as well perhaps in view of the rate the high-pressure lighting has bounded forward in the Company's area. But notwithstanding the rate, the Company's resources have been equal to it all. In this district as in others, electric lamps of all sorts have had to give way to the high-pressure lamps.

A Notable Display.

A cinematograph theatre is passed, where flame arcs have been displaced, and high-pressure lights have taken their place, owing to the proprietor's preference for the greater brilliancy of the light of the latter. There is a remarkable sight ahead—a sight we imagine that cannot be seen elsewhere (save still farther along in the Lewisham High Road) in London. Along the pavement on one side of the road is a row of about fifty standards with curved heads on the depending portion of each of which there is fixed a 1500-candle power high-pressure lamp. We stop a minute or two to admire the effect in perspective. It is remarkable; to the gas man extraordinarily delightful. With the curve of the pavement there seems to be almost a miniature forest of standards and lights. As we pass by them, there is no blinding effect—an essential in these days of fast moving traffic in busy streets—and strong, soft light is thrown all over the roadway, paths, and shops; and where there are high-pressure lamps on both sides of the roadway, the lighting is simply perfection. There is the nearest approach to a sunlit street that we have come across. It is an ordinary week-day evening. The footpaths are alive with people. People go where there is light. There is something magnetic about it; and tradesmen have learnt this, just as many of them have learnt, and are spreading the intelligence, that high-pressure gas-lamps give illumination *par excellence* for trading purposes. We are approaching a row of 3000-candle power lamps; and they, too, make a remarkable display. Here is situated one of the several handsome show-rooms for which the South Metropolitan Company have rightly a reputation. At the back of these is the district compressor-station. "Imitation is the sincerest form of flattery." Hard by on the other side of the street the South Metropolitan Electric Supply Company have a show-room fitted on very similar lines—without high-pressure gas-lamps along the exterior! The high-pressure "parade" system is well patronized hereabouts, and there are some exquisite examples of high-class lighting. The premises of James Collinwood, among others, attract notice. Before quitting this area, we take a dip into the Lee High Road to see the high-pressure lighting there. In the Lewisham area, there were, at the end of December, 386 high-pressure gas-lamps, of which 11 are of 3000-candle power, 94 of 1500-candle power, 145 of 1000-candle power, and 136 of 500-candle power.

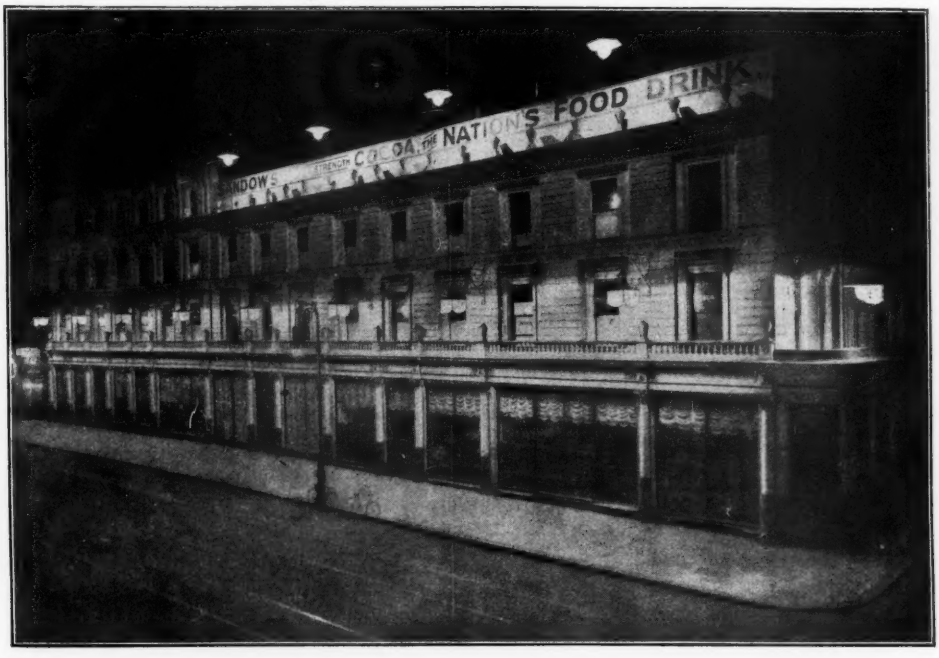
Another Remarkable Display in Lewisham High Road.

We leave this district, where competition for the shop lighting has been conducted with a smart rivalry, and has resulted in gas lighting making such a splendid showing. But there is a mile ahead another high-pressure system, and a sight worth seeing, with some independent testimony of a character that is very gratifying. The testimony of lighting itself is of material importance; but still more important is that of independent consumers who know what they want in regard to illumination, and are pleased when they get it. This particular system towards which journey is being made takes in Lewisham High Road and Deptford. As we travel over the intervening ground between the Lewisham High Street and Road, in Loam Pit Vale (there is no high-pressure main in this part) a small shop is noticed with a couple of outside low-pressure gas-lamps alight, and an electric arc unlighted suspended between. Inquiry brings a strange piece of information. The arc lamp is only used on Saturday night! Still more economical for the tradesman are the low-pressure gas-lamps during the other nights of the week. Again we have an opportunity of examining the effect of the low-pressure "Metro." inverted burner in the street-lamps; and there is seen a vast improvement on what used to obtain when the vertical form of incandescent burner was in use in the locality.

But here we are approaching the high-pressure lighting in the Lewisham High Road. "A perfect vista of light" is the expression that unpremeditatedly escapes the lips. On standards along the footways are supported 1500-candle power lamps. Again it has to be said that the sight must be seen to be appreciated. In the roadway and on the footpaths, one could see quite well to pick up pins, if this were a necessary occupation. The roadway and footpaths are simply bathed in an illumination that could not be exceeded for its purity and quality; and there is no sense of any uncomfortable glare. The footway high-pressure lighting here is paid for by the Lewisham Traders' Association. They know that light and trade go together; and they have secured the most reliable and best quality of light extant for this special purpose. In the midst of it one is tempted to linger. We are attracted by the display of high-pressure lighting at the huge drapery establishment of Messrs. Pyne Bros. The premises have been extended. Along the front, there are 24 500-candle power high-pressure lamps; and there are twelve similar lamps in the crowded little arcade that forms part of the extension of the premises. It is observed that the firm rely entirely upon the high-pressure lights for illuminating their richly-dressed show windows. No lights are needed among the goods. Suspension of electric lights among goods in windows has brought disaster to many drapery establishments. It is not a Saturday night on which the visit is paid; but even so ladies are thickly ranged along the window fronts inspecting the goods, which they can do without inconvenience to their eyes. The colours of the fabrics and the other goods exposed for sale present themselves in what appeals to us as being their natural colours. The old part of the premises (which forms the greater part) was previously lighted outside and inside by electric lamps. They have been abolished; gas reigns supreme—inside through the aid of the "Metro" low-pressure burner, and outside by the high-pressure lamps. More pleasant lighting for customers and those employed on the premises there could not be.

Independent Testimony as to Exterior and Interior Lighting.

The writer steps inside the shop of Messrs. Pyne Bros., for the purpose of making inquiry as to what the Manager (Mr. W. J. Ely) thinks of the lighting. The visit is an unexpected one; it is, in fact, an intrusion on the time of a busy man. But Mr. Ely receives the writer courteously; and he soon proves himself to be at once an enthusiast on the question of illumination for the



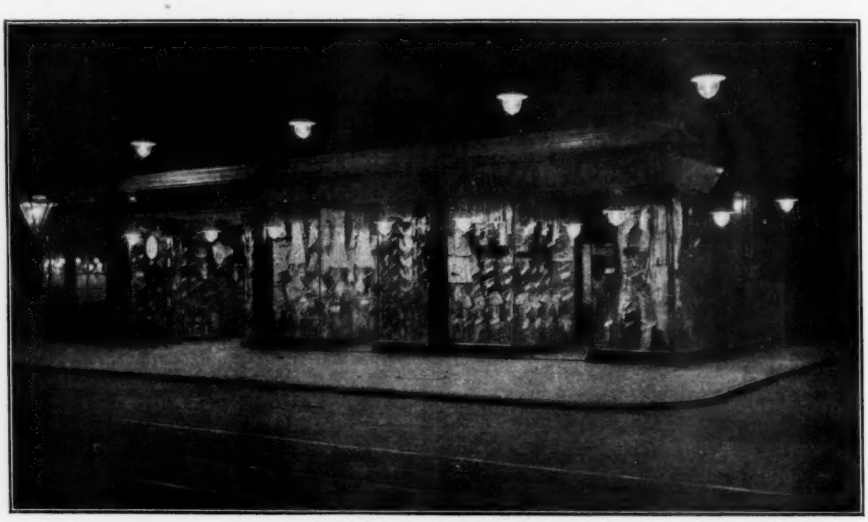
HIGH-PRESSURE LIGHTING AT SANDOW'S LTD., NEW KENT ROAD, S.E.

special class of business confided to his charge, and perfectly independent as to whom he patronizes for illumination. He is Chairman of the Lewisham Traders' Association, who were instrumental in raising the attractions of the road to the present scale through the lighting. Mr. Ely told the writer that he was more in favour of the high-pressure lighting to-day than he was when it was first put in. In his opinion, it has been the making of the road as a trading centre. He speaks from a personal experience before and since the change; and it has, he said, meant for them all in business there an enlarged market. From the practical point of view, he mentioned that, in the drapery business perhaps more than in any other, the matching of colours is an important matter. Incidentally we may remark that Mr. G. Arthur Pyne, the chief of the firm, is held in great respect in the drapery trade, and is a recognized authority. Before there was experience of high-pressure gas lighting, the best light Mr. Ely had found for matching difficult colours and delicate tints was the white light of the old enclosed arc. In view of his want of experience at the time with the high-pressure lamps, one of these arcs was retained when the change in lighting was made; but, large and varied as is the firm's business, that lamp has never been brought into use—the high-pressure lighting having been perfectly satisfactory for colour matching purposes. That is the unprejudiced experience of a tradesman who knows practically of what he is talking. His experience with the former electric arc lamps was not a happy one. The flickering of the lights was irritating to the customers; the dropping of the carbons was annoying; and when out of some 26 lamps, perhaps six or eight gave trouble in a single evening, patience was severely tried. And, he added with a smile, "when the lights happened to all go out, though perhaps only temporarily, people went home." "What about the inside lighting?" he was asked. His statement was that he takes great interest in watching and keeping an account week by week of the readings of the lighting meters; and he can say that the "Metro" burner is the most economical he has come across. What also is very important in the drapery business is that he finds (to use his own description) that it is a "clean burner." The softness and diffusion of the light, too, are good; and, in short, he is so pleased with the illumination that he is going to fit up other departments with the burner. There was no claim upon Mr. Ely to tell the writer these experiences; he did it quite voluntarily. He further added that he does not think the low-pressure gas-light is so good for colour matching as the high-pressure; but it is superior for this purpose to the incandescent electric light, though not to the old white electric arc. Mr. Ely is thanked for his courteous reception, and for the information as to his experiences. But there was a parting shot from him, to the effect that, while he is satisfied that he has the best light available at the present time, if any better light for the purposes of the firm comes along—whether electric or otherwise—if the Gas Company cannot come up to it on the essential points, they will in time have to clear out. That is only fair. In this, as in other things, it is Mr. Ely's business to do the best possible for his firm.

After the pleasant chat in the office of Messrs. Pyne Bros., the car was remounted; and we passed through and away from the striking evidence of progressive lighting in the Lewisham High Road, which as already mentioned is connected up to the Deptford high-pressure gas system, to which, consulting the list kindly provided, the writer finds there were 297 lamps connected at Dec. 31 last—92 of 1500-candle power, 122 of 1000-candle power, and 83 of 500-candle power.

At Peckham.

A little bit of quick travelling through New Cross Road brought us to Peckham. Gas has not got things all its own way here. There is the big drapery emporium of Messrs. Jones and Higgins, electrically lighted by means of current generated by steam-driven plant. However, as a set-off to this, in other parts of the Gas



HIGH-PRESSURE LIGHTING OF MESSRS. KING AND EDWARDS' PREMISES IN THE OLD KENT ROAD.

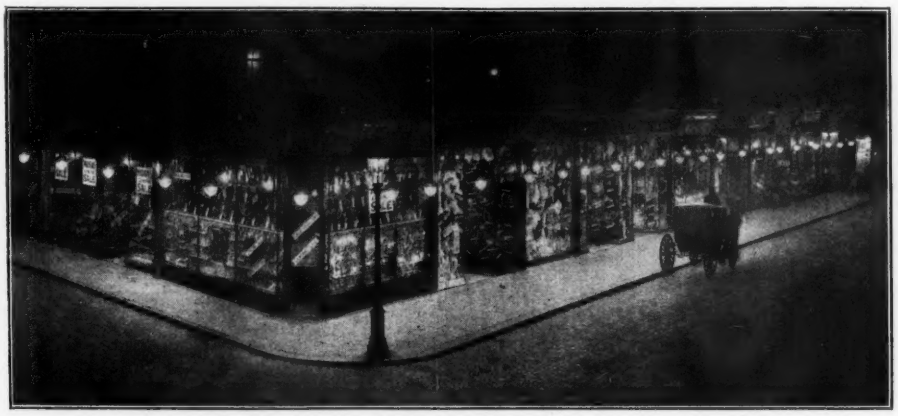
Company's area, there are extensive establishments generating electricity, by their own coal-gas-driven plant, cheaper than they can purchase it from outside, and without being subject to some of the risks that in public electricity supply exist everywhere between generating-station and point of use.

As we journey along, several important high-pressure installations are seen. At Wade's pianoforte establishment, for instance, a large difference has been made in the immediate neighbourhood by putting up some twenty 1500-candle power lamps under a five-year contract. We see the electric arc lamp arms still in position. There are, also, stretches of the High Street, Peckham, where there are high-pressure lamps, depending from the shop fronts, on both sides of the road. The car is turned into Rye Lane; and, after leaving Messrs. Jones and Higgins' premises, we see that the high-pressure lamps are making good strides here in winning ground and custom. Arc lamps have fallen before them, and will continue to do so. Although the fight is so keen in this district, the Peckham compressing station can claim the largest number of connections—511; but Walworth, our next shopping centre, comes close on its heels with 459 connections. Walworth can nevertheless claim a larger candle-power connection. However, the Peckham system, our sheet of statistics informs us, had connected at Dec. 31 28 1500-candle power lamps, 432 of 1000-candle power, 50 of 500-candle power, and one of 300-candle power.

At Walworth—Cinemas and Strength.

Running along to Camberwell Green, we again have an opportunity of inspecting the street-lamps and the low-pressure shop-lamps; and the former observations are everywhere confirmed as to the excellence of the maintenance practices of the South Metropolitan Company in regard both to shop and street lighting—as to the former, the hire of lamps includes in all cases their maintenance. The Company are strong believers in the business protection virtue of maintenance by their own staff. Passing along, a block of Peabody Buildings is seen, containing 250 tenements; and it is interesting to note that the poor occupying these tenements are in the enjoyment of good lighting by the "Metro" burner. This is as things should be; there is no need for the poor to be committed in these days to an ancient form of indifferent lighting. Here is a picture palace outlined by electric incandescent lamps, and showing a dull, lifeless frontage. Round in a neighbouring road is another cinema, the proprietor of which has made his place an attractive and effectual competitor by the wealth of illumination he obtains from the sparkling light sources furnished by his high-pressure gas-lamps. The opposition place must come into line to get equality in attractiveness.

We quickly traverse Camberwell Road to Walworth Road. The aspect of the latter has been completely changed by the lighting. Though darker night never was, far ahead there is a clear view of objects and people in the good illumination that prevails. There is no need to ask whether the lighting is popular in this area. When the number of shops with the lights installed is observed, as the people on the footways and inspecting the shop windows are observed, there is the sufficient answer. High-pressure gas lighting has brightened Walworth; and those who know Walworth will say with the writer that the enterprise of the tradesmen has been not only an advantage to themselves, but is a local improvement, and so they are public benefactors. On the Walworth system, as already remarked, there were at Dec. 31, 459 lamps, of which 17 were of 3000-candle power, 104 of 1500-candle power, 296 of 1000-candle power, and 42 of 500-candle power. We see again the displacement of electric arc lamps at various places in this neighbourhood. At one establishment—Messrs. Whitlock's—there are seen the old electric lamps between the new high-pressure ones. It used to be gas-lamps that were changed to electric for shop lighting; it is the turn now of electric lamps to



A CORNER OF RYE LANE, PECKHAM.

be changed to gas-lamps. The Southwark Borough Council, who own the electricity supply undertaking in this borough, have altered the street arc lamps to the latest form of flame arc, which is the greatest compliment the high-pressure lamp could have paid to it. It goes on performing its duty, despite the compliment, without the slightest agitation, which is more than can be said for the flame arc neighbour. At William Hurlock's general stores, there is an attractive arrangement of high-pressure lamps suspended well up the building, and lower (near the shop windows) are low-pressure lamps. The effect is good. We turn the corner, and just have a peep at Sandow's cocoa establishment, which is lighted by 3000-candle power high-pressure lamps both near the top of the building and down below. Round each unit of the lower range of lamps, there is an advertising screen; and the light of a high-pressure lamp is excellent for this purpose. A dentist, too, in Newington Causeway, has eight of the 1500-candle power lamps with advertising screens round them right up the front of his premises. It is an effective means (and so is becoming more and more popular) of making an advertising display.

Clapham and Balham.

We are now in the Kennington Park Road; and running along an experiment is noticed in street lighting. In one part of this road, the public lighting is in the hands of the Borough of Southwark, and on the other side in those of the Lambeth Borough Council. The experiment consists of 100-candle power Osram lamps being placed in lanterns on standards, of which there are four to every two single "Metro" burner gas-lamps on the other side of the road. Nevertheless, the illumination of the electric lamps is very little better though spaced such a short distance apart; but the colour and diffusion of the light from the inverted burner gas-lamps is distinctly superior. We are in Clapham now and running from normally illuminated roadway into the shopping area where good patronage is found for high-pressure gas-lamps. Clapham and Balham form one high-pressure system, as there is no doubt that in time along the main road the intervening residential property will be converted into shops. Again trading premises are seen, the outside lights of which were formerly electric, and are now high-pressure gas. There is an excellent display at the drapery premises of Mr. Richard Williams. There cannot be any lingering to pick out all the most attractive examples. We run on through Balham High Road; and in passing notice how the large handsome lanterns outside a public house have been converted to the high-pressure system.

At Balham there is a tremendous show in the main street. The number of lamps in the area being at Dec. 31 last 346; while in the Clapham High Street, there are 227. In Balham, there are side streets where the tradesmen have taken up the new lights, in order to divert people from the main thoroughfare to the less imposing shops. In one street, the writer learnt that the landlord of the shops had had high-pressure lamps placed in front of them, in order to add to their letting attractions. Of the 227 lamps in the Clapham High Street, 2 are of 4500-candle power, 3 of 3000-candle power, 6 of 1500-candle power, 210 of 1000-candle power, and 6 of 500-candle power. Of the 346 lamps at Balham, 46 are of 1500-candle power, 275 of 1000-candle power, and 25 of 500-candle power.

At Streatham.

We just take a short run to Streatham; and there again the display is of really magnificent order. There is great similarity between Streatham and Balham as shopping centres; and both are determined to keep their own trade at home. At Streatham there are on the system 293 high-pressure lamps, of which 88 are of 1500-candle power, 151 of 1000-candle power, and 54 of 500-candle power. When one examines the number of lamps of the different candle powers in each neighboorhood, it is interesting to observe how the higher powers are patronized in some areas more than in others.

The End of the Tour.

The writer has come to the end of his forty-mile tour of some of the principal shopping centres in the South Metropolitan Gas Company's supply area. It has been highly instructive and genuinely gratifying. Of the popularity of high-pressure lighting among the tradesmen, what more solid evidence could be given; it is so popular that it is self-advertising. We remember the words of Mr. Carpenter, when presiding at the last meeting of the proprietors of the Company, that orders for high-power lamps now came in to the Company unsought. There is no reason to ask why after this experience. Nowadays, in the Company's area, it would be sheer waste of time for any competitor to attempt to decry this form of illumination. There is the ocular and material demonstration to refute any adverse allegation that may be made. It is possible by other means to get an equal quantity of light in a restricted area, but not of such quality. It is commercially impossible to obtain an equal quantity of illumination (without taking count of quality) so economically by other means. Knowledge of what is and what can be in high-power gas illumination

IN STREATHAM HIGH ROAD, S.W.

has been supplied by this tour; and the reward of a striking enterprise has been witnessed.

HIGH-PRESSURE LAMPS ON DISTRICT AT DEC. 31 LAST.

Assembled together, the statistics of the high-pressure lighting in the South Metropolitan Gas Company's district referred to in the foregoing article, and others not alluded to in it (excepting the lamps on isolated private plants), we have the following:

District.	300 C.P.	500 C.P.	1000 C.P.	1500 C.P.	3000 C.P.	4500 C.P.	No. of Lamps.
Lee Green	..	40	11	10	..	..	61
Brixton Road	..	..	5	25	..	..	30
Eltham	..	..	5	..	..	..	5
Streatham	..	54	151	88	..	..	293
Balham	..	25	275	46	..	..	346
Peckham	1	50	432	28	..	..	511
Lewisham	..	136	145	94	11	..	386
Southwark Park Road	..	37	18	49	..	..	104
Deptford	..	83	122	92	..	..	297
Woolwich	..	12	123	9	..	..	144
New Grand Hall, Camberwell Green	..	..	..	5	7	..	12
Walworth	..	42	296	104	17	..	459
Clapham High Street	..	6	210	6	3	2	227
Clapham Junction	..	6	43	..	..	..	49
Norwood	..	44	150	7	..	..	201
Lambeth Town Hall	..	..	..	8	3	..	11
Totals	1	535	1986	571	41	2	3136

ELECTRICITY v. GAS FOR STREET LIGHTING.

Reflections by a French Engineer.

IN the current number of the "Journal de l'Eclairage au Gaz," M. Grebel, to whose contributions to French gas literature frequent reference has been made in the "JOURNAL," deals in the opening article with various subjects of general interest, including the one mentioned. He acknowledges that his remarks are only of a chatty or conversational character; but they are none the less worthy of attention. We give below an indication of their nature.

M. Grebel remarks that electrical engineers have been much impressed by the success of the high-pressure incandescent gas-lamps. Very dazzling electric arc lamps are to be seen in some of the principal squares and streets of Paris. They give a somewhat unsteady yellow-reddish or white light; and they can be recognized by the kind of cylindrical pot hanging under their relatively small and almost transparent globes. They are flame arcs, and consequently very wavering, with mineral carbons always very heterogeneous. Whatever care may be expended upon the manufacture of the core or wick of these carbons, which contain strontium and other metallic salts, isomorphous mixtures cannot be obtained. Moreover, the influence of the exterior coat of carbon becomes momentarily predominant, as can be observed with the eye when the violet tint characteristic of ordinary carbons tends to reappear. The consumption varies from 0·2 to 0·5 watt—an average of 0·35 watt—per lower hemispherical candle, with good mineral carbons, with the globes, which are far too transparent, adopted for these new lamps. It is therefore much less than what could be obtained in similar circumstances with ordinary carbons (0·8 watt).

These arcs, mounted in pairs and connected in series on 110 volts, are made for 8, 10, and 15 ampères; and they attain powers comparable with those of high-pressure gas-lamps—viz., 2000 lower hemispherical candles—for the 15-ampère lamps. Their working in an almost closed globe reduces the consumption of the carbons. The air is but slightly renewed. The heavy dust (consisting of small pieces of carbon) falls into the receptacle under the globe, while the light dust is collected in one over it. For an equal production of luminous power, a much smaller length of mineral carbon can be employed than of ordinary carbon, so that there is a great saving of labour for maintenance. Moreover, it is the same with carbons as with mantles; their influence on efficiency is considerable.

M. Grebel considers that the electricians are quite right to make powerful light sources; but he submits that they should not be allowed to employ, for public streets, globes which are not opaline, and which do not reduce the fatiguing glare of the arc. To say nothing of the disagreeable tint of mineral arcs, the flame arcs, though their consumptions are relatively small, waver too much for street lighting, for which one of the first qualities should be steadiness. To be convinced of this, one has only to try to read a few lines of a newspaper at the foot of one of these lamps, the intensity of which fluctuates considerably.

Taking as the actual practical average consumption of the newly installed street arc lamps 0·45 watt (instead of 0·35 watt), with loss in the rheostats, per lower hemispherical candle-hour, and 0·7 litre instead of 0·6 litre for high-pressure gas-lamps, the rough costs per carcel-hour are comparable, as follows: Flame arcs: (0·45 watt × 35·3 c.) ÷ 100 = 0·159 c. High-pressure gas: (0·7 litre × 15 c.) ÷ 100 = 0·105 c.

M. Grebel thinks comparisons between high-pressure gas-lamps in which there may be mantles with too great resistance and little lighting power, and arc lamps which can be made to give anything momentarily, with soft carbons, are not to be trusted. In this respect, he says he should not like to qualify a certain experiment recently carried out in Manchester.

In his closing remarks, M. Grebel says electricians could not fail to make an effort to overtake gas engineers. However, between the beautiful fixed golden light of high-pressure gas-lamps, which does not fatigue the eye, and the flickering light, of extravagant tint, of flame arc lamps with mineral carbons, the glare of which, with almost transparent globes, is insupportable, comparison is not just. To elude this grave objection, electricians assert, by way of argument, that the public have become accustomed to the flame arc since it has been used for lighting shop-fronts, saloon bars, &c. M. Grebel says the public submit to this kind of lighting as used for advertising; but their eyes will be none the better on this account. This argument, therefore, is fallacious and valueless. Gas engineers, however, will, he suggests, do well (to employ two stereotyped phrases) to "remain in the breach," and not to "rest on their laurels."

A Twelve Million Cubic Feet Holder for Australia.

In the "JOURNAL" last week (p. 113), reference was made to the gasholder to be erected for the Australian Gaslight Company at their Mortlake works. We understand that the Engineer concerned in the preparation of the plans was Mr. Andrew Wilson, who some few years since went out to Sydney (N.S.W.) as Assistant to Mr. Thos. J. Bush, M.Inst.C.E., Engineer to the Company.

Sources of Error in Pressure Indication.

In the course of a paper on "Indicators" submitted to the Institution of Mechanical Engineers last Friday, by Mr. J. G. Stewart, of Dundee, he dealt with the several sources of error in the indication of pressure. One of these was the sampling of diagrams, which he said had scarcely received sufficient attention. He pointed out that without proper care large errors in the indicated power might be introduced. The difficulty was greatest where the area of the diagrams was subject to large variation. In a steam-engine, with a good governor, sampling was comparatively easy; but in a gas-engine the variation in diagrams was often large, particularly if it was working on power gas. In a gas-engine test in which cards, each of three working cycles, were taken every five minutes throughout an hour (36 diagrams in all), a difference of 1·7 per cent. was found between the average of all the diagrams and the average of the first 30. The effect of large or small diagrams in causing such a divergence becomes less as the total number of diagrams increases. In the particular test instanced, in which the load was artificial and of constant amount, the maximum variation of one of the sets of three diagrams from the mean was about 8½ per cent. In one instance, two successive sets each gave 8½ per cent. above the mean. Roughly, those occurring together represent an excess of 17 per cent. above the mean. In order that two such diagrams occurring at the end of a test should not affect the final result by more than 0·5 per cent., Mr. Stewart said that it would be necessary to take 34 sets of diagrams—*i.e.*, almost three times the number actually taken. Mond gas was used in the test, and the mixture was weak. With richer mixtures, the variations are not so large. In a test giving a mean pressure of 92 lbs. per square inch, the greatest variation from the mean of any one set of diagrams was 5 per cent. In order that two such sets occurring at the end of a test should not affect the results by more than 0·5 per cent., 20 sets of diagrams would require to be taken.

Professor Lewes on "Liquid Fuel."—At the Royal Society of Arts last night, Professor Vivian B. Lewes, F.I.C., F.C.S., delivered the first of a series of three Cantor Lectures on the above-named subject. He indicated the liquid fuels which are available, dealt with petroleum and its composition, and offered some remarks on the distribution of oil. The lecture will be noticed next week.

Night Views of the Cities.—In the last number of the "JOURNAL," two examples were given of night photography. A section of our American contemporary "Good Lighting" for last month contains eight striking photographs of this kind taken in New York and elsewhere. It is remarked that night seems to be a medium for the expression of light in all its wondrous effectiveness; and it is intended to depict periodically night views illustrating the lighting conditions in the cities of America and other countries.

Mr. Butterfield's Lectures on "Chemistry in Gas-Works."—It was mentioned in the "JOURNAL" for the 17th ult. that Mr. W. J. A. Butterfield, M.A., Assoc.Inst.C.E., F.I.C., would give two lectures on the above-named subject at University College, Gower Street, W.C. The first was given on Dec. 18, and was noticed in the issue for the following Tuesday (p. 966). The second will be delivered on Friday, the 31st inst. In this lecture, Mr. Butterfield will deal, among other things, with the qualifications and training requisite in a gas-works chemist.

THE GAS SUPPLY OF MUNICH.

THIS instalment brings to a conclusion the series of articles dealing with the Municipal Gas-Works of Munich, prepared from the "Commemoration Volume" issued by the Corporation of the city. In the previous articles (pp. 22-8 and 91-8), the progress of the gas supply under municipal control was dealt with and descriptions were given of the carbonizing plant, the coal and coke handling machinery, and the various apparatus installed at the Dachauerstrasse Gas-Works. The lighting of the works, the accommodation provided for the comfort of the workmen, constructional details, a description of extensions in progress at the time the volume was issued, the distributing system, and the public lighting form the subject of the present article.

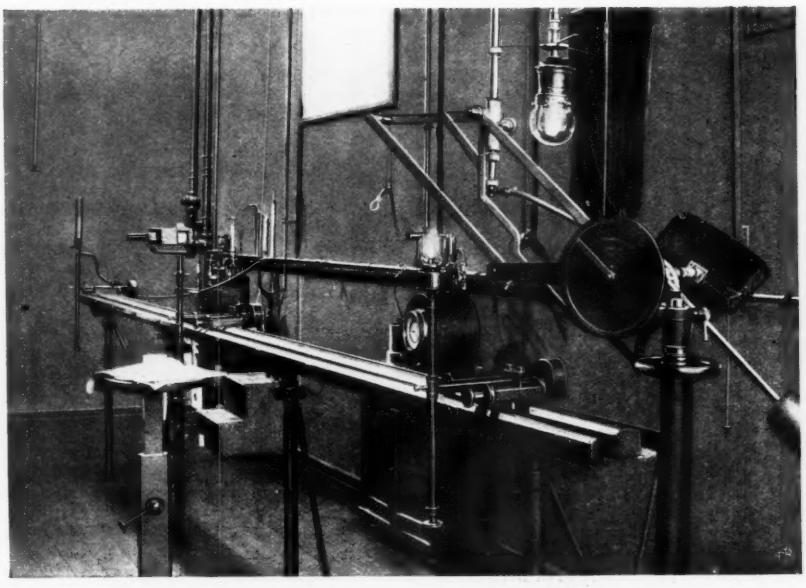
LIGHTING OF THE WORKS.

The works are lighted, as far as possible, with gas; the busier spaces being illuminated with high-pressure gas, for which twelve lanterns, each with two inverted burners of 900-candle power, are provided at a height of 18·4 feet from the ground. The rest of the roadways and spaces on the works are lighted with low-pressure inverted burners of 145-candle power. Upright burners are used for the lighting—from outside—of the apparatus rooms. Electric lighting has been employed wherever gas lighting cannot be safely used without considerable difficulty, or where only intermittent lighting is required, as in the basement of the apparatus house. It has also been used for lighting all the conveying plant. Arc lamps have been employed for the outside lighting of the coal-shed and the interior of the electric power house. For other interiors 45-candle metallic filament lamps have been used, except on the conveying plant, where, chiefly on account of the vibration, 28-candle carbon filament lamps have been adopted.

WORKSHOPS AND STORES.

Having regard to the extensive equipment of the works with machinery, shops have been provided on a corresponding scale. The fitters' shop comprises twenty benches for fitters and smiths, a room for tool makers, a room for three electrical fitters, a joiners' shop, and a sack-sewing room. The shops are provided with lathes, boring, shaping, planing, and threading machines of all sizes, a one hundredweight pneumatic hammer, and various machine tools. Three electrically driven sewing machines are used for making and repairing sacks. Each machine in the shops is driven from a separate electro-motor by means of a band.

The basement of the stores' building contains, *inter alia*, the store-keeper's office and stores for the heavier reserve parts. The lighter and more delicate reserve parts are stored on the upper floor. Special provision is made for the storage of lubricating oil, which is filtered on arrival and pumped into four closed iron tanks, which are under air pressure, by which the oil is forced out as required for use. A room, with a reinforced concrete roof, is provided under the distributing platform of the coal-shed, for the storage of fire-brick and other constructional materials.



ANGULAR PHOTOMETER USED FOR TESTING AT THE WORKS.

CLOAKROOMS, BATHS, &c.

An up-to-date cloakroom and baths have been provided in a building on the west side of the works, near the entrance. The rooms on the ground floor are for the day labourers; those on the upper floor for the mechanics. The bath house contains waiting rooms, rooms for drying wet clothes, and, in the basement, stands for 45 bicycles. Each workman has an iron clothes-chest divided into two compartments, so that clean clothes may be kept away from working clothes. The bathing provision includes four baths, 21 shower baths, and 38 wash basins. The shower bath cabinets are 4 ft. 3 in. by 3 ft. 6 in. The hot water supply is obtained from two boilers heated by copper steam coils to 158° Fahr.

The canteen, with accommodation for 140 men, has been erected between the bath house and the workshops. Here hot and cold meals and drinks of all kinds are sold at local prices. The coffee and tea kitchen, under the works management, supplies coffee and tea of the best quality, with sugar, but without milk, at a trifle over ½d. per quart.

LABORATORY AND DWELLING HOUSES.

The laboratory, in addition to the ordinary chemical work room, has rooms for the analysis of coal gas, coke, and coal, a balance room, and a distillation and drying room. There is a spacious photometer room, and, in the basement, storerooms for samples and chemicals.

Three houses have been erected to provide dwellings for the works' engineer, two works' foremen, two mechanics, two carbonizing foremen, two electricians, and a porter. Near the entrance and the porter's dwelling is a small building with weighing machine for the sale of coke by retail. To the left of the entrance are the offices, containing reception and council rooms, pay office, and offices for the chief engineer and his assistants.

CONSTRUCTIONAL DETAILS.

The outside walls of the coal-shed up to a height of 18 feet from the ground level are of rammed concrete, and above this height, of iron lattice work filled in with brick work rough-cast inside and out. The walls between the bunkers, which carry the four overhead lines, are of concrete like the outside walls; but the bottoms of the bunkers are reinforced with iron. The channel for the band conveyor in the middle of the coal-shed has a girder framing and rests at the side on massive concrete walls. This channel is ventilated by Monier chimneys rising up in the coal-store from the points where the supports for the corrugated roof and the lining for the travelling crane rest on the side walls of the conveyor channel. In order to protect the stokers from the weather, and to diminish the radiation of the heat from the settings, an iron framing, filled in rough-cast inside and out, has been erected so as to form a carbonizing house 220 feet long and 46 feet deep. There are 17 girders which, on the side next the coal-shed, serve to transmit the wind pressures to the foundations, and also as supports to the coal conveying plant. At a height of 23 feet from the ground is the producer stage, which is connected by a bridge to the reinforced concrete bracket of the coke reservoir. The travelling stage for the discharging machine is 9·8 feet higher, and over this is the stage for the coal-charging apparatus.

The settings are exposed on the discharging side, and at the two ends of the carbonizing house are staircases leading to the different stages. The channel leading from the carbonizing house to the apparatus house is entirely of reinforced concrete. It is 16 ft. 6 in. wide inside, 11 ft. 6 in. high, and 289 feet long. Numerous openings with glass prism covers light it sufficiently by daytime. The apparatus house, meter-house, governor house, boiler-house, producer-room, stores, and the electric power station, have all been built alike, as follows: The brick outside walls rest on a concrete foundation reaching 3 ft. 9 in. above the ground. On these walls the iron frame of the roof rests. The roof consists of a double boarded lining covered with flat tiles on roofing felt. Owing to its greater span, the roof framing of the apparatus house has sliding bearings. The wind pressure is taken up by struts. The reservoirs above the exhauster room of the apparatus house are carried on a bayed reinforced concrete roof, which has a clear span of the room.

The elevated tar and liquor tanks rest on massive concrete

curbs. The iron tanks themselves are surrounded by a Monier casing, and protected by a Monier roof. The intervening space can be heated by steam. The water-tower and the liquor concentrating house are in iron and concrete, with the base bricked-in. The main girders of the ammonia concentrating plant are arches with three angles in reinforced concrete, having their bases connected by the reinforced concrete roof between the cellar and the ground floor. The purifying house is constructed of concrete up to the reinforced concrete roof of the revivifying floor. This roof rests on 72 reinforced concrete columns, and it carries the weight of the purifying vessels and connections. The space above the purifiers, which is 68 ft. 9 in. in width, is covered by the roof framing in a clear span. For ventilation of the revivifying floor, there are on the east side of the building Monier ventilating slots reaching up to the eaves of the roof in alternate spaces between the columns of the building. The intervening spaces are taken up by the windows. The upper floor is ventilated by being roofed with channelled tiles on a lattice framing of wood.

The reservoir (of 10,595 cubic feet capacity) for the coke for the producers, the sheds, and the trough from which sacks and waggons are filled with coke, are constructed entirely of reinforced concrete. The producer coke reservoir is simply supported on four columns somewhat spread at their base, and at the top coming to the angles of the opening through which the coke is withdrawn. On brackets on these columns is carried the producer charging line, at a height of 23 feet from the ground; and over this, attached to the roof of the bunker, is the reserve line for the transmission of coal. In the roof, which is covered with asphalt, is a slit 6 ft. 6 in. in width, through which the elevator waggons discharge the coke into the bunkers. The sack-filling shed rests on 24 reinforced concrete columns, and is constructed so that between the outer roof and the floor on which the sack-weighing machines are is a bunker of 35,000 cubic feet capacity. The roof platform contains the bunker with openings closed by lids. Above it runs the electrically driven line whence the sorted coke is emptied into the concrete bunker. The waggon filling trough, or long bunker, of 21,190 cubic feet capacity, is similarly constructed.

The construction of the works was carried out in the manner described with the object of adapting it, as far as possible, to the structural material available, and to providing simple means for obtaining good working results. The grouping of the buildings was to a large extent determined by the position of the railway and the conveying plant, which were, of necessity, more or less unalterable. Special importance was attached to securing well-ventilated and light basements and ground floor rooms. In the interior equipment the use of costly materials was avoided; only the exhauster room and the engine room of the electric power station having tiled walls and floors. The rest of the walls are distempered, with stained skirtings and wooden floors.

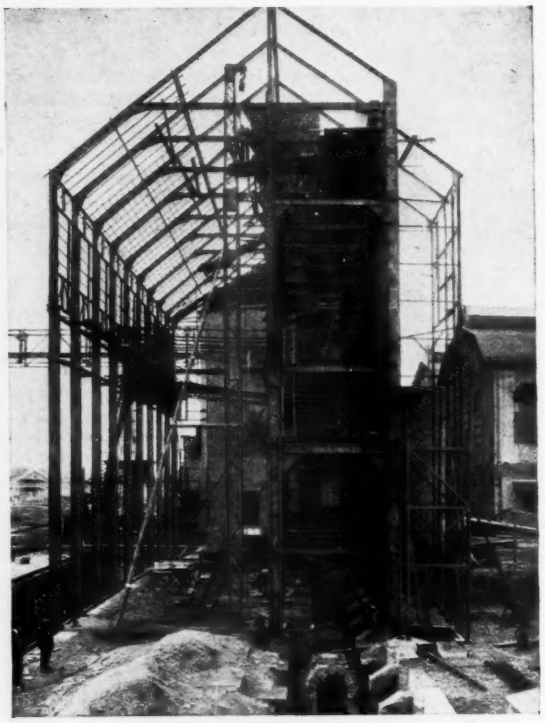
Constructional Work Now in Progress. [Second Stage.]

The Corporation decided in the spring of 1911, to proceed with the second stage of the construction of the gas-works—*i.e.*, for a further productive capacity of 1¾ million cubic feet per diem. The extension comprises the erection of a second carbonizing house for sixteen settings of Munich chambers, half of which settings will be erected first, and the coal conveying plant required for this carbonizing house.

New Carbonizing Plant.

The eight settings of carbonizing chambers for the second instalment are being carried out generally on similar lines to those of the first stage of construction of the works; but their capacity has been increased to 17½ metric tons (17·2 English tons), and some simplification of construction has been introduced. In all the changes, greater facility of service of the settings has been kept in view. The new type of fittings of the chambers has first been tested in the setting of the experimental gas-works, and the improvements have thus been thoroughly tried in all respects. A change has been made in the discharging machine, which is being constructed as a simple, light travelling crane, to be moved by hand. The driving of the ram has been simplified, and better provision made for working it in case of failure of the current.

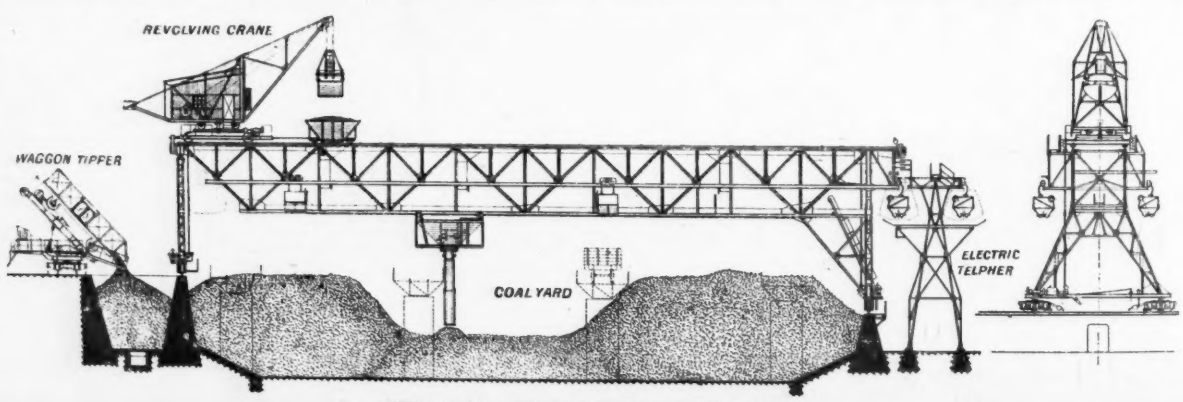
A new construction has been adopted for the coke quencher. On the whole, the present arrangement for quenching answered well; but there is considerable wear and tear on the De Brouwer conveyor, and the large coke is very much crumbled by it. Experiments on a large scale undertaken in the late spring of 1910 showed that good quenching is secured if water is introduced from below into the vessel containing the coke. The new quenching arrangement consists substantially of a wrought-iron water-tight riveted tub which is lined inside with cast-iron plates. These plates are so arranged that the water can pass in and out of the quenching tub without hindrance. At the bottom the tub has two large leaves, which are closed by pressure on two cast-iron frames. Thus the tub can be rapidly filled with water and emptied as quickly as possible; a large valve, worked by hand, being used for the outflow of the water, which is pumped away by two low-pressure centrifugal pumps of high capacity. The water is then pumped up into a quenching water reservoir, and the loss by evaporation is made good by fresh water from the mains. The quenching machine carries also the appliance for raising the discharging doors of the chambers, a rake for removing scurf, and a shaft for carrying off the steam produced, as well as a spacious covered platform for the driver. The quenching tower is worked from this platform almost entirely by electric power. For the sake of keeping down maintenance charges, the exterior of the tower is made as smooth as possible.



SECOND CARBONIZING HOUSE, UNDER CONSTRUCTION.

Carbonizing House.

The carbonizing house is intended for sixteen beds of carbonizing chambers, each of a productive capacity of 212,000 cubic feet per diem. The house is 253 feet long and 43 feet wide. The top of the settings is about 42 feet above the ground level, and, in order to give sufficient space for the overhead coal bunkers to be placed at the proper height and inclination, the height of the ridge of the carbonizing house has been made 75 feet. The framing of the house is formed of box girders, the horizontal members serving to carry the stages, while the central stays take up the vertical loads. The roof framing is strongly trussed; the roof over the coal-bunkers rests on the central and north-side props. The

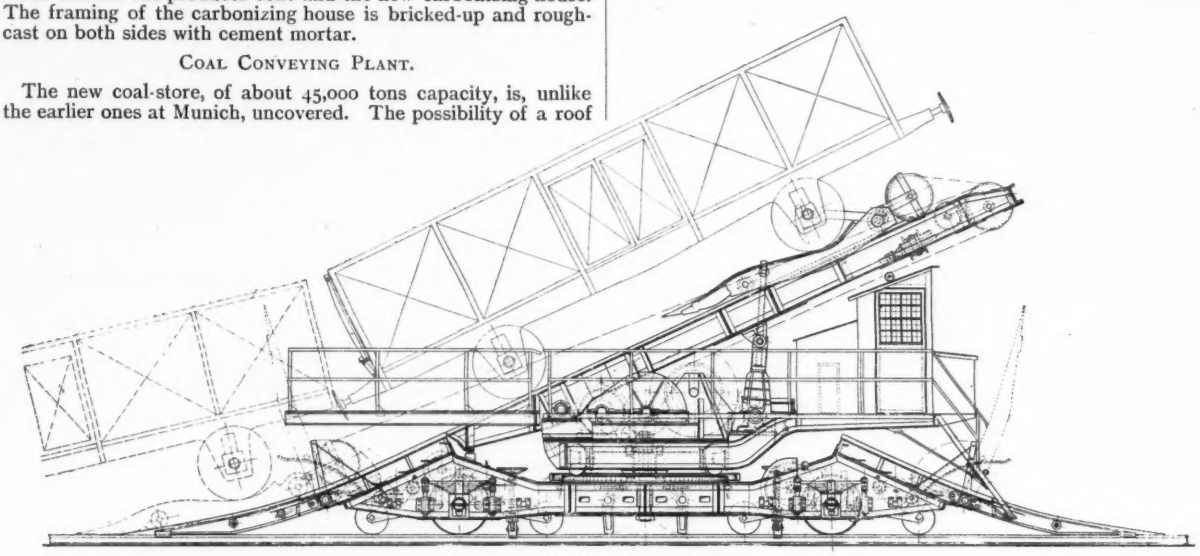


NEW COAL CONVEYING PLANT AND STORE.

front wall of the house is entirely independent of the framing of the settings. The travelling stages in the carbonizing house are of corrugated plate, where there is much dirt, but elsewhere of perforated plates, for the sake of better ventilation. The house is ventilated by a longitudinal opening, 10 feet wide, in the ridge of the roof. This opening can be closed by flaps in case of very heavy rainfall. Large windows are provided in order to secure plenty of light in the house. The coal containers are of such a size that each section holds the necessary quantity of coal for one carbonizing chamber. The staircase is at the back of the house, separated from it by doors, and alongside it is the shaft with the reserve coal conveying plant. The new carbonizing house is being connected at each stage with the existing carbonizing house, in order that the stokers may pass from one to the other. Two coke-grabs are to be provided between the overhead reservoirs for the producer coke and the new carbonizing house. The framing of the carbonizing house is bricked-up and roughcast on both sides with cement mortar.

Coal Conveying Plant.

The new coal-store, of about 45,000 tons capacity, is, unlike the earlier ones at Munich, uncovered. The possibility of a roof being subsequently required for it has, however, been kept in mind. The coal, arriving on the viaduct in tipping railway waggons, will first be discharged from them by a rotating and travelling waggon tipper into a pit alongside the line and in front of the coal-store. Grabs, worked from a revolving crane on a travelling bridge over the store, remove it from the pit into electric telpher waggons. The latter convey it to the breaking plant alongside the retort-house, and a bucket-conveyor raises it thence into the bunkers of the chamber settings. The rotating waggon tipper travels on a standard gauge line, and can work through a series of waggons standing on the line. The waggons are first drawn up a plane at an angle of 30 degrees attached to the tipper, then swung round by 90 degrees, and after the door has been opened, raised higher and thus discharged into the coal pit. After discharging, they are delivered on to the track on the other side of the tipper. This arrangement avoids the necessity for any special shunting of the waggons into position; and after they have been tipped, they can be coupled up again and removed by the State railway.

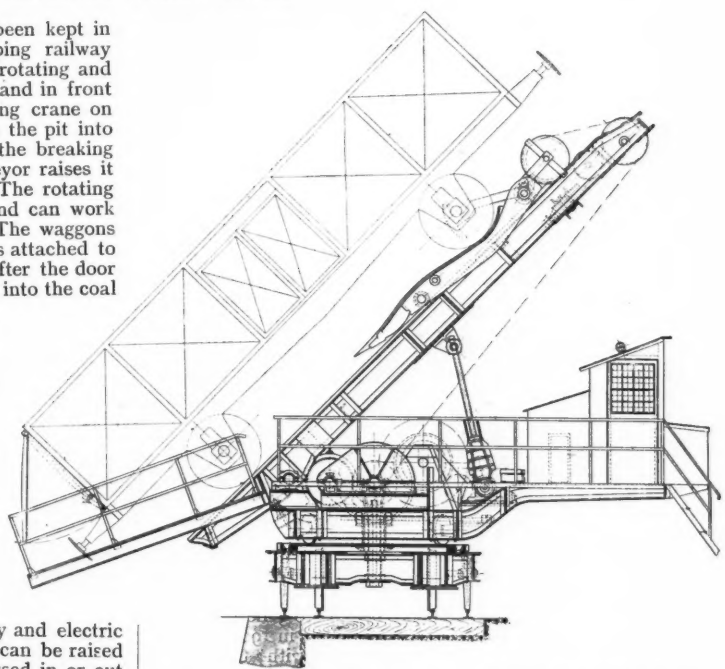


THE REVOLVING WAGGON TIPPER.

The revolving grab crane, by which the coal is removed from the pit, has a range of 29 ft. 6 in. and can lift 7½ tons. The crane and the bridge on which it is mounted are driven entirely from the crane driver's platform on the revolving crane. The grabs are of about 160 cubic feet capacity, with two ropes. The discharging drum of the grab is normally lifted by friction during raising and lowering, and for discharging is stopped by a special brake. The crane driver's box has been made of ample size, in order to make the machinery and electric equipment in it conveniently accessible. The roof can be raised so that heavy parts of the equipment may be passed in or out through it by means of a travelling crane, which will be referred to later. Travelling on the same rails as the crane, and attached to it, is a conical hopper, into which the grabs can discharge when the crane has been rotated. The coal may be drawn off from this hopper into the electric telpher waggons at six different places. Coal to be put into store is distributed directly by the revolving crane, which travels at the rate of 5 feet per second. The bridge on which the crane is carried is of lattice construction, with a main support on the carbonizing house side and a lighter support on the tipper side. The bridge is driven by two electromotors which are connected by a strong transmission shaft in order to secure equal travel of the feet of the two supports. The rate of travel is about 20 inches per second.

The electric telpher line forms a closed circuit; but the circuit is divided into a number of block sections, in which one waggon remains until the preceding waggon is clear of the next section. There are ten waggons, each equipped with a 1 H.P. motor. The waggons have a content of 88 cubic feet, so that the working capacity of the installation averages 100 tons of coal per hour. There is also, in case of breakdown of the revolving crane, a framing, provided with two rails, in front of the coal breaking house, having a similar revolving crane. This reserve framing or trestle has a travelling crane for use in case of larger repairs. The coal-breaking plant is to consist of four breakers, each to deal with 60 tons per hour. Above the breakers are screens, from which only coal exceeding 4 inches in size goes to the breaker. For the time being only two of these breakers have been installed. They are placed one behind the other, at right angles to the axis of the retort-house.

The waggons of the electric telpher line discharge their contents into a central shoot, without stopping; and from this shoot the coal runs on to the screens. The breaking and screening



space is completely closed in, so that coal dust will not escape. The electro-motors used for driving the breakers are enclosed, and the casings ventilated from outside. Thus no dust gains access to them. The coal is watered before and after the breakers, so that dust extracting apparatus, which is costly and never very thorough in action, is dispensed with. The coal from the breakers and that which has passed through the screens go together to a receiver, from which the charger of the two bucket conveyors is to be filled. For the time being, only the westerly of the two conveyors is being installed. This bucket conveyor is similar to that of the earlier plant, but is of 100 tons per hour capacity, instead of 40 tons. A lift of 4 tons capacity, provided for carrying goods and men, will serve also as a reserve plant for conveying coal in case of breakdown of the conveyor. This lift travels at the rate of 1 foot a second, and will raise two trucks, each of 52·5 cubic feet capacity, which can be discharged from the side into the coal receivers. The coal conveying plant in the car-

bonizing house will have a maximum capacity of 125 tons, and an ordinary average working capacity of 100 tons per hour.

Distributing System and Distribution.

In the first thirty years of the Munich gas undertaking, the distributing system emanated from the old works in Thalkirchnerstrasse. With the erection of the Kirchstein Gas-Works on the right side of the River Isar, it became necessary to lay two trunk mains from these works across the river to the town distributing system. One of these, which crossed the Maximillian Bridge, was 28 inches in diameter, and the other, which crossed the Ludwigs Bridge, was 18 inches in diameter. With the extension of the Kirchstein works a further trunk main to the town became necessary. When the Prince Regent's Bridge was constructed across the river in 1893, a main of 32 inches diameter was laid across it; but its use was delayed until street widenings in the town favoured the laying of a new main from it. Before this main was laid, however, the Prince Regent's Bridge was destroyed by floods in 1899, and with it a portion of the main crossing it. This was not restored until the year 1900. A 28-inch main was laid from its end on the left bank of the river to the old gas-works. When the Dachauerstrasse works were erected, a 40-inch main, dividing into one of 32 inches and one of 28 inches, was laid to connect the works with the existing distributing system. The 32-inch main was connected with the 28-inch and 24-inch mains from the old Thalkirchnerstrasse works; and these connections, with the mains from the Kirchstein works, afforded a complete circuit of trunk mains in the town, by which a supply at uniform pressure could be afforded.

When the gas-works passed into the possession of the Corporation in 1899, the length of mains was 206 miles, with an average diameter of 7·56 inches; while at the end of last year the length was 285 miles, and the average diameter 8·36 inches. On Nov. 1, 1899, when the works were taken over, only 5764 houses, with 18,495 consumers' meters, were connected. At the end of last year, 12,639 houses, with 101,229 meters, were connected. The steps taken to increase the gas consumption included the provision, up to the end of 1911, of 6658 service pipes to houses, and 8084 prepayment meters put in at the expense of the Corporation. The heating and cooking apparatus on hire numbered 31,993. Since July 1, 1911, simple lighting fittings have also been supplied on hire.

Public Lighting.

When the gas-works was taken over by the Corporation, there were in use for public street lighting, in addition to 844 electric arc lamps, and 250 electric glow lamps, 5869 lanterns, each with one incandescent gas-burner. At the end of last year, the number of street lamps was 10,588, with 11,228 incandescent burners; while the number of electric lamps was 993 arc and 200 glow lamps. The gas consumption of the public lamps was computed to be last year 114,685,284 cubic feet. Since the year 1907, the inverted burner has been gradually introduced in the public lamps; the lanterns having been adapted to take them. At the end of 1911, there were 2578 inverted burners, partly one and partly two in a lantern.

BYE-PRODUCT RECOVERY AT COKE-OVENS.

In the last number of the "Journal" (p. 106), brief reference was made to a paper read by Mr. J. E. Christopher, at a meeting of the Manchester Section of the Society of Chemical Industry, on "Progress in Bye-Product Recovery at Coke-Ovens." The following are some points in the paper which were not then touched upon, and for supplying which we are indebted to the reader of the paper.

Early attempts at the recovery of bye-products were first described; illustrations being given by lantern of the Pernolet and Aitken ovens, and of the older type of condensing plant and sulphate plants. The average yields of bye-products per ton of coal in these ovens were given as 7 gallons of tar and 5·4 lbs. of sulphate; while the contemporary yields in gas-works were given as 10 gallons and 16 lbs. respectively (in 1877). The combination of enclosed ovens (Pernolet) with those of the retort shape (Coppée) was dealt with; the author leading up to the pioneer bye-product oven in this country—the Simon-Carvès (1881). The progress in late years was shown in diagram form.

Interesting illustrations of modern ovens were exhibited and explained by the author, who commented on the Koppers oven in describing the type used on the Continent for gas lighting, in which the flues are fed by producer gas. He also described the Semet-Solvay oven, with its continuous regenerator designed on similar lines to those of the gas-works recuperative system. Next followed a detailed description of the various ammonia processes, semi-direct and direct—these being presented in diagrammatic form; while a detailed comparison was shown of the above types with and without benzol recovery. In this comparison, the author dealt very fully with the quantity of effluent produced, the thermal losses entailed, and the capital and working costs. The apparatus used for extracting tar in these processes was well illustrated. The author then described a typical tar-distillation plant, and gave an illustration of the Hennebutte process. Crude benzol plants and benzol rectification plants were next shown, together with distillation curves of motor benzol, petrol, &c. He discussed the outlets for tar, and gave the total output in 1910 as: Great Britain, 990,000 tons; Germany, 822,617 tons; the United States, 331,516 tons. The outlet for benzol most likely to expand was stated to be its use in the motor spirit industry. The imports of petroleum spirit were given as being 19,459,010 gallons in 1905, 26,335,120 gallons in 1906, and 33,180,480 gallons in 1907.

The question of surplus gas was next dealt with; the author giving the following as an average analysis from four distinct coke plants:

	Per Cent.
Illuminants	2·4
Marsh gas	28·8
Hydrogen	54·1
Carbon monoxide	5·0
Carbon dioxide	2·0
Oxygen	0·4
Nitrogen	7·3
	100·0
Average calorific value	510 B.Th.U. net.

The gradual change in the composition of coke-oven gas at various stages of carbonization was well shown by diagram; and Mr. Christopher expressed the firm opinion that a "modern coke plant, given the same quality of coal as supplied to gas-works, could, with reasonable care, turn out regularly an average gas suitable for the modern conditions of gas lighting." Progress on the Continent and in the United States in the quality of gas sold from coke-ovens was shown by the following figures, in millions of cubic feet: Ruhr district—1903, 13¾; 1905, 24½; 1907, 77¾; 1908, 400; 1909, 843; 1910, 1472; 1911, 3020. In the United States, in 1910, the quantity sold was 12,000 millions.

Referring to the project for the supply of coke-oven gas to Ghent, alluded to last week, Mr. Christopher said he did not suggest that the manufacture of gas in coke-ovens would ever displace the modern vertical retort, with its advantages of continuous carbonization; but an attempt had been made to show the value of the surplus gas as a bye-product pure and simple.

WATER-WORKS CONSTRUCTION DIFFICULTIES.

Compensation Water and the Divining-Rod.

In the course of a paper on the construction of water-works, and the difficulties attending it, which was read by Mr. C. E. Newton, M.Inst.C.E., last Tuesday, before the Manchester University Engineering Society, he alluded to the trouble caused to the water committees of municipalities by reason of vested interests. He said the engineer who had to prepare a scheme for the storage of naturally drained waters had, in the first place, to remember that he could not do anything without giving compensation to the owners of the water. The law protected the rights of ownership in everything, water included; and the riparian owners of any stream interfered with had to be compensated for twenty miles down. In a few instances money compensation had been paid; and it was not uncommon for water authorities to buy up mill properties to muzzle opposition in Parliament. Generally, however, the compensation was given in water. The right to be compensated consisted in the enjoyment and benefit to the land of a stream of clear water passing it, with a minimum dry-weather flow which might be of little use for power, and a fluctuating excess, which was sometimes a disastrous flood. It was therefore to the advantage of the landowner to have a continuous and even flow; and a rule had become recognized by which the regular quantity of water sent down the stream should be one-half of that which was taken away. In spite of this rule, however, the matter was often contested in Parliament, and it had been argued that the dry-weather flow should be allowed in addition to the third part of the produce of the storage reservoir, on the ground that the owners of the banks enjoyed this quantity as a constant, for which they ought to have special compensation.

At the close of the paper, some discussion took place on the value of the divining-rod, which Mr. Newton said he had found to be of use in discovering faults and fissures in the geological structure of the hills banking several reservoirs.

Next Monday, at a joint meeting of the Staffordshire Iron and Steel Institute and the Birmingham Metallurgical Societies, Professor Bone, F.R.S., will deal with the subject of "Surface Combustion."

We learn from the Hon. Secretary (Mr. David Fulton) that arrangements have been made for the members of the Western District Division of the Scottish Junior Gas Association to visit the Pumpherston Oil-Works on Saturday. As it is considered a privilege for the Association to be allowed to inspect these works, the Council hope there will be a good attendance. At the next ordinary meeting, on the 8th prox., Mr. Thomas Carmichael, of the Dawsholm Gas-Works, will read a paper on "Gas for Heat, Power, and Light."

NEW PLANT AT THE BELFAST GAS-WORKS.

VERTICAL RETORTS, TELPHER COKE-HANDLING PLANT, AND A SPIRAL-GUIDED GASHOLDER.

A LARGE scheme of extensions at the Belfast Corporation Gas-Works, which has been designed and carried out by the Engineer and Manager, Mr. James D. Smith, was inaugurated yesterday. The new plant consists of an installation of vertical retorts, coke-handling plant, and a spiral-guided holder; and these were fully described in an excellent *brochure* (from which the following particulars are taken) prepared in connection with the ceremony.

The History of the Undertaking.

The property of the Belfast Gaslight Company was transferred to the Corporation under the authority given by the Belfast Corporation Gas Act of 1874. The purchase-money was £432,083. The make of gas was then 416 millions; but this continued to grow rapidly, until for 1912 a figure of 2338 million cubic feet had been reached, and the increase still continues. The price of gas in 1874 was 4s. 6d. per 1000 cubic feet, less discounts of from 2½ to 20 per cent. Rent was also charged for meters; but this was abolished by the Corporation in 1879. To-day the price of gas is only 1s. 9½d. net; and the capital liability is no more than £165 per million cubic feet manufactured.

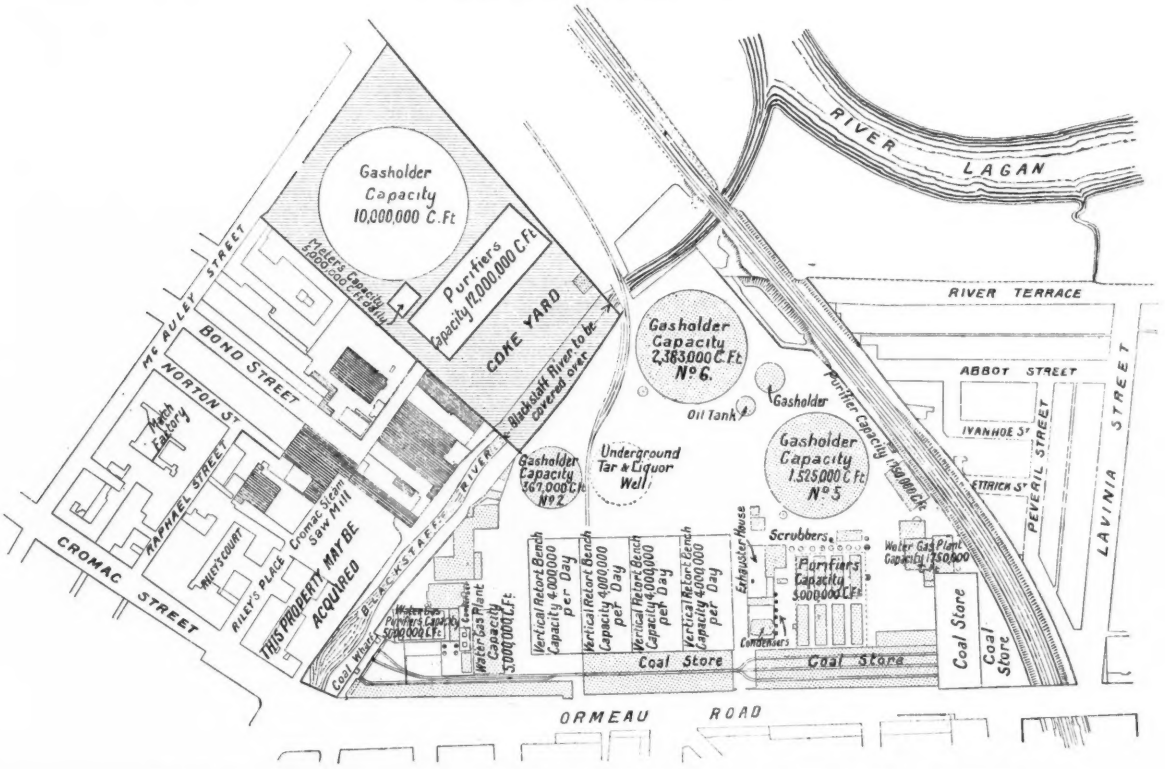
In 1891, an attempt was made to obtain more ground for extensions, and the low-lying ground in Ormeau Park was recommended for this purpose. But public opposition was so strong that the proposal had to be abandoned. As the need for more producing power was imperative, some way had to be found out of the difficulty; and eventually, after full inquiry, it was decided to adopt the carburetted water-gas plant supplied by Messrs. Humphreys and Glasgow. This proved so successful that, a year later, a plant of more than double the capacity of the first was ordered; the combined total of water gas being equal to the production of 6 million cubic feet of gas. By this time, the purifiers were unequal to the amount of work demanded; and as no ground space was then available, large overhead purifiers were erected in 1896. These works, with other alterations and additions, carried the undertaking on till the appointment of the present Engineer, in 1910, when he was called upon to report as to the best means of providing for future requirements.

His report was submitted on Nov. 11, 1910, and was adopted by the Gas Committee and the Council. The main provisions were: The acquisition of 4 acres of land known as the abattoir ground, and the erection thereon of a large gasholder and tank. To substitute vertical retorts for the present carbonizing plant; the retort-houses to be centralized and arranged in units. When extensions were finished, these should be equal to the production of 16 million cubic feet of coal gas. To erect a bridge over the Blackstaff River, so as to unite the ground space on each side. To abolish existing holders Nos. 1 and 2, and double the capacity of Nos. 4, 5, and 6. To erect additional purifiers and station-meters. To provide modern coal and coke handling plants, &c.

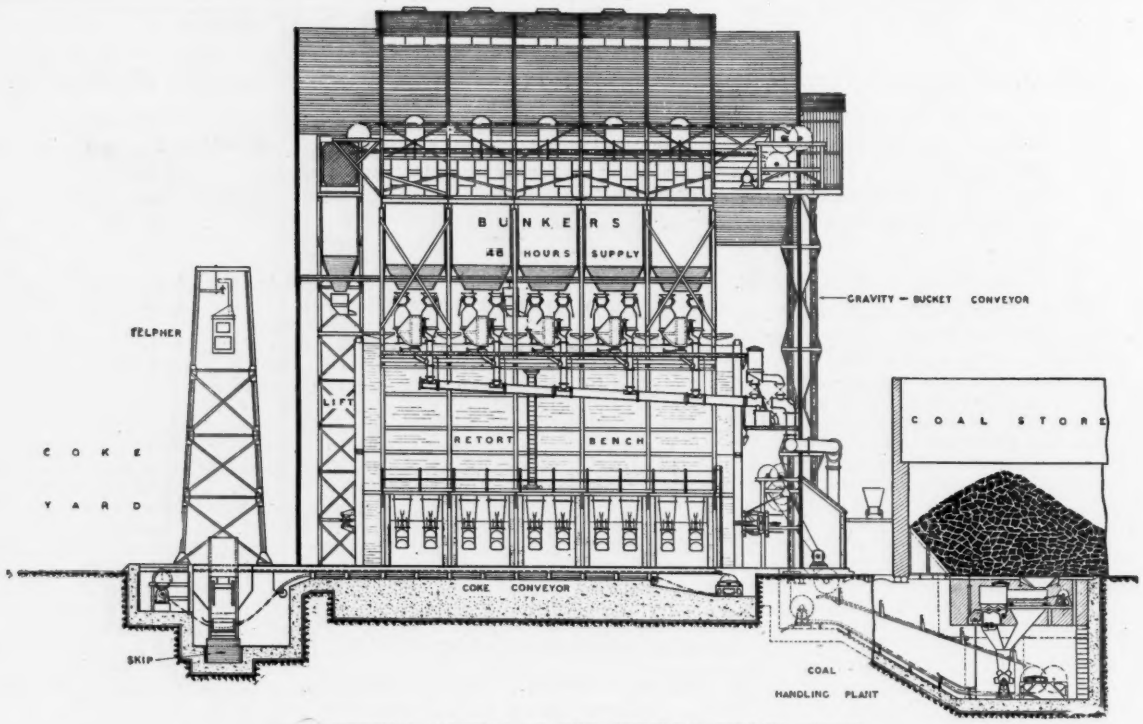
Immediately after adoption of this report, the necessary specifications and plans were prepared; and Messrs. West's Gas Improvement Company, of Manchester, secured the contract for erecting vertical retorts. It was also decided to remove No. 5 gasholder at once, and to erect a four-lift spiral-guided holder in the existing tank. This work, as well as the coke-handling plant, was given to Messrs. Robert Dempster and Sons, of Elland.

In 1912, a Gas Bill was promoted in Parliament by which powers were obtained to acquire land on the north side of Blackstaff. Many other items relating to the price of gas for prepayment meters, illuminating power, &c., were included in the Bill, as well as the necessary authority to raise money.

In connection with this account of the extensions of the Belfast Corporation Gas-Works as carried out to date, it may be interesting to reproduce from the "JOURNAL" for Nov. 29, 1910, the plan prepared by Mr. J. D. Smith to accompany his report to the Gas Committee on the then existing works and his scheme for their extension. Mr. Smith concluded his report with these words: "The total cost of the completed scheme, as shown on the plan, would be about £600,000, exclusive of the outlay on the ground to be acquired. . . . It will not be necessary to spend all this money at one time, but to undertake the work in four sections. The first section would cost (exclusive of ground) about £250,000, which would be spread over four or five years; and the balance would only be expended when found necessary. In conclusion, I have no hesitation in saying that if these works are reconstructed on the lines indicated, they will be quite capable of supplying all the gas required by the City of Belfast during the next sixteen years."



PLAN OF THE ALTERATIONS PROPOSED AT THE ORMEAU PARK (BELFAST) GAS-WORKS.



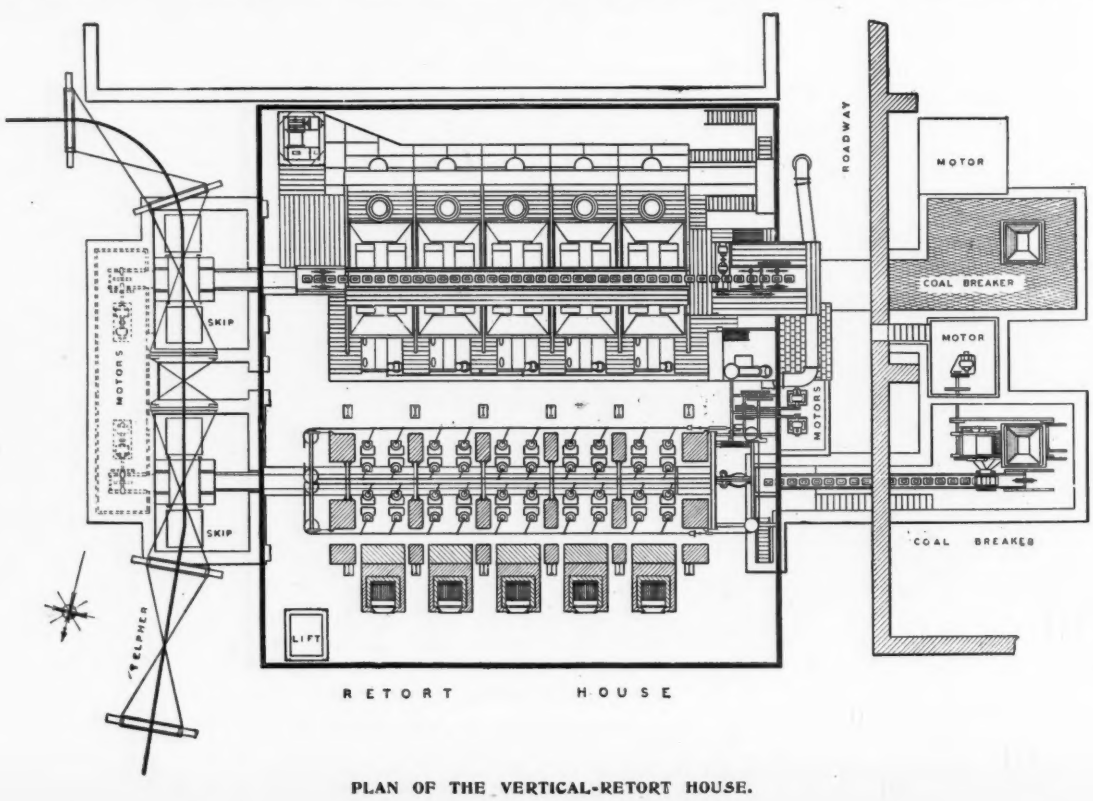
LONGITUDINAL SECTION OF THE VERTICAL-RETORT HOUSE.

The Glover-West System of Continuous Carbonization in Vertical Retorts.

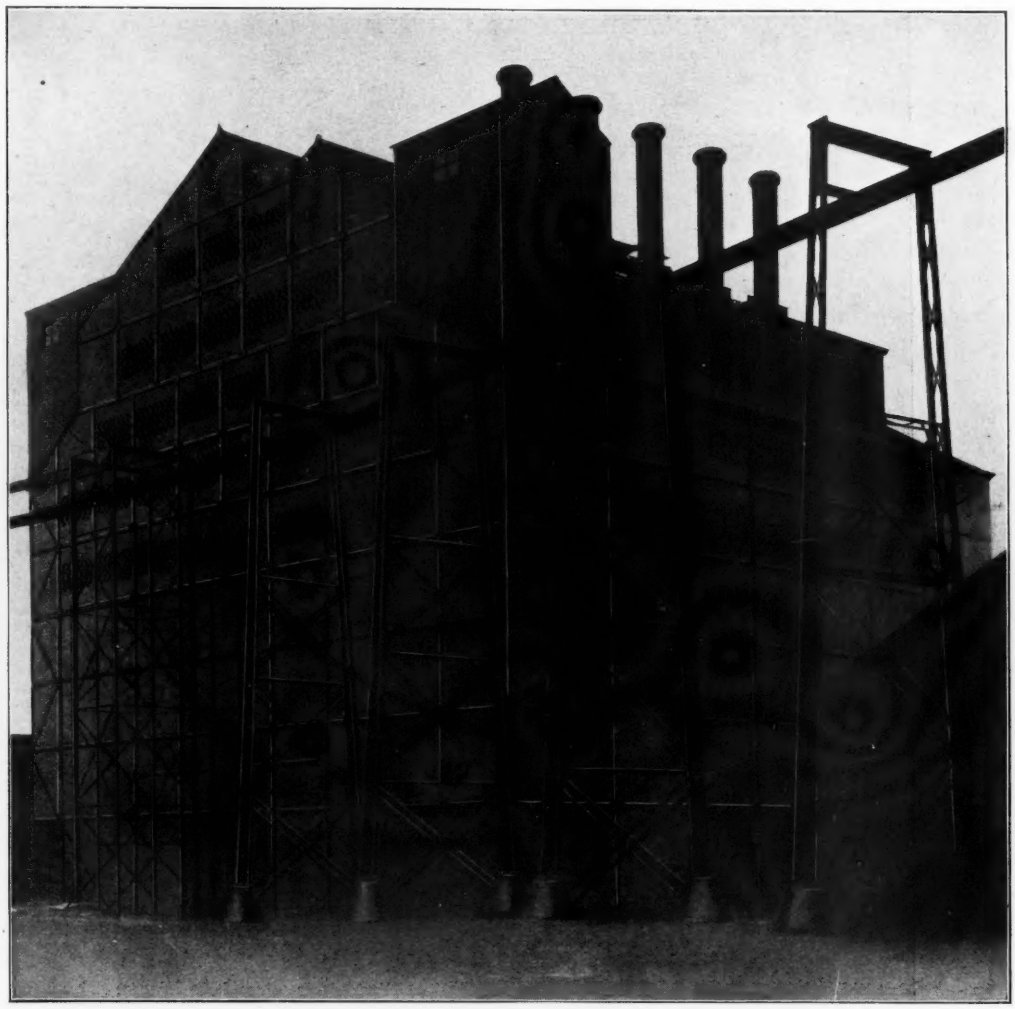
The recent extension of the carbonizing plant at the works has been effected by the building of a retort-house containing two benches of Glover-West vertical retorts on the continuous system of carbonization, with coal and coke handling plant; the capacity of the new plant being 2½ million cubic feet of gas per diem. Apart from the economy in the cost of carbonization, the increased production of gas and coke from the coal, and the improved quality of the bye-products which are expected from the new plant, the Glover-West process is especially applicable to the requirements of the gas-works at Ormeau Road in respect to the cleanliness and the absence of nuisance in the operation of gas manufacture. As the installation occupies less ground-area than is required by plants of the horizontal and inclined retort systems of similar capacity, it is possible eventually to replace the existing old horizontal retort-houses by vertical retort installations, which would increase the producing capacity of the works to such an extent as to avoid the necessity of acquiring a site for a new gas-works to meet the city's increasing demands for gas.

The new retort-house is situated on the site which was formerly a coke-yard, where a portion of the coke from the horizontal retort houses used to be stored. The Glover-West vertical retort plant is conveniently placed near a coal-store opposite the gable end of the retort-house. This coal-store is supplied with coal by light railway waggons on overhead railway tracks, which also serve the whole of the coal-stores at the works. The two retort-benches in the new retort-house are arranged parallel to each other; and each bench contains five settings of eight retorts, heated in units of four—making a total of eighty retorts in the complete installation.

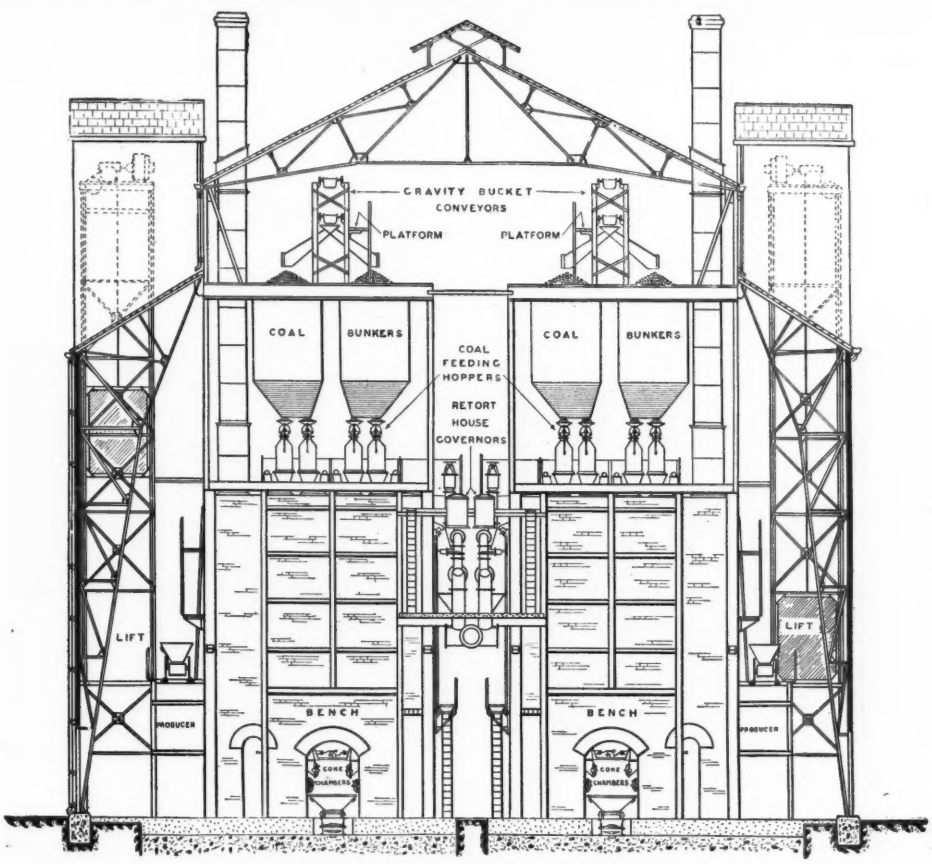
The coal is conveyed from the coal-store by two lines of coal-handling plant, one for each retort-bench. Each line of plant comprises: A coal-hopper, from which the coal is received and fed by a reciprocating feeder to a coal-breaker. This feeder is fitted with a screen to enable small coal to be fed to the conveyor without passing through the breaker. A West's breaker, with two



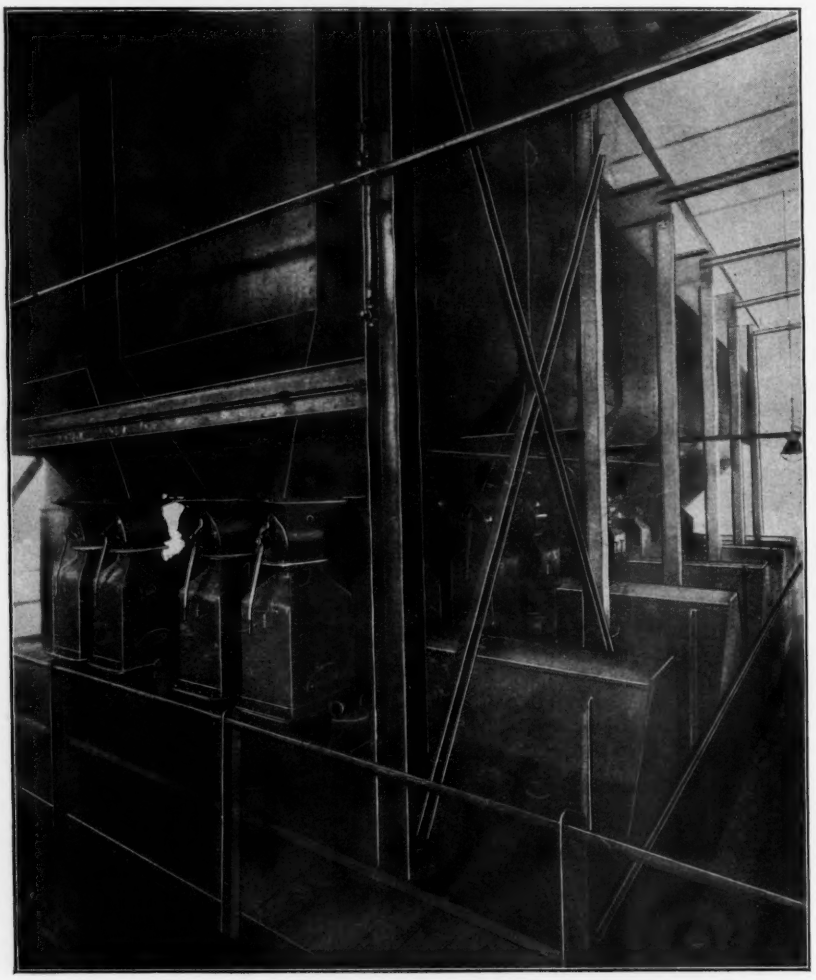
PLAN OF THE VERTICAL-RETORT HOUSE.



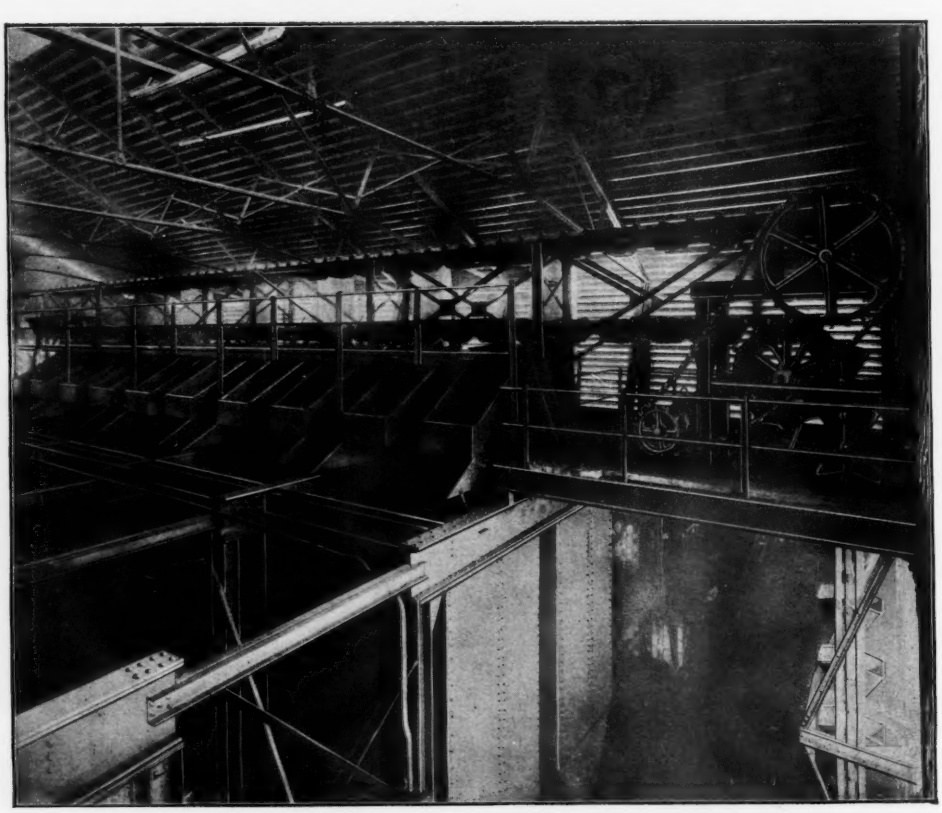
THE GLOVER-WEST VERTICAL-RETORT HOUSE AT THE BELFAST CORPORATION GAS-WORKS.



TRANSVERSE SECTION OF THE RETORT-HOUSE.



COAL BUNKERS AND RETORT-FEEDING HOPPERS OF THE GLOVER-WEST VERTICAL RETORTS AT BELFAST.



GRAVITY BUCKET COAL CONVEYOR AND COAL BUNKERS OF THE GLOVER-WEST VERTICAL RETORTS AT BELFAST.

pairs of cast-steel claw rolls. A coal-conveyor of the gravity-bucket type. The coal is elevated by the gravity-bucket conveyor, and is discharged into the coal-storage bunkers above, and of the full length of the retort-benches.

Each line of coal-handling plant has a capacity of 50 tons of coal per hour. The capacity of the storage-bunkers above the retort-benches is 48 hours' supply to the retorts. Above each retort there is a coal-feeding hopper, which receives its supply of coal from the opening in the coal-bunker immediately above it. This hopper is fitted with a rotary coal-inlet valve, and contains about three hours' supply to the retorts, through which the coal is continuously descending, and becomes completely carbonized by the time it arrives at the point near the base of the retorts.

The coal which is converted into coke then passes through the lower ends of the retorts, and is cooled by air which circulates around the bases of the retorts. This heated air forms the secondary air supply to the combustion chambers, which are arranged in horizontal superimposed floors; each floor being distinct from the others. The producer gas is supplied from a generator common to the eight retorts of the setting. The producer gas rises through vertical flues, and is admitted to the several floors through nostrils controlled by dampers. The waste gases from each combustion chamber are led through flues and circulating chambers around the top ends of the retorts, afterwards making their exit to chimneys, of which there is one to each setting. The Glover-West system of heating the retorts is unique in the design of gaseous-fired settings, as the heat from the residual coke is utilized, resulting in considerable economy in the fuel consumption when compared with the ordinary regenerative system. Further, the coke is discharged from the retorts in a comparatively cool state, and does not require quenching.

For each retort there is a coke-extractor, in the form of a helix, which is rotated at a very slow speed by variable-speed ratchet driving gear, which can be quickly adjusted to control the speed at which the coal passes through the retort, thus readily adjusting the time of carbonization to suit any kind of coal. The coke from the retorts is temporarily received in coke-chambers, from which it is periodically discharged to a West's coke-conveyor, which conveys the coke to a point outside the retort-house where it is received by a "Telpher" transporting plant. The gas ascends in the retort to an outlet at the side of the coal-feeding hopper, and is led through a valve to a condensing main, which is provided with gas and tar outlet-valves. From the condensing mains, the gas and tar are conducted through foul mains, which are provided with a retort-house governor having the usual bye-passes with valves and connections. For inspecting and attending to the various parts of the vertical retort plant, there is an ample provision of staircases and platforms; and, in addition, there is a lift for each retort-bench, which not only serves the purpose of raising the coke required for the producer gas generators, but is also employed for raising the coke needed for filling the retorts when they are first put into operation and after they have been scurfed. The lifts serve also as auxiliary coal-elevators to the coal bunkers, in case of need.

The retort-house building consists of a light, but well-braced, steel frame, which is filled in with a screen of light brickwork; openings being left for forming doors, windows, and ventilators. The roof of the retort-house is constructed as part of the main building frame, and is covered by slates. The whole plant is electrically driven by separate motors for the several sections; the motors for the coke-extractor driving gear being in duplicate.

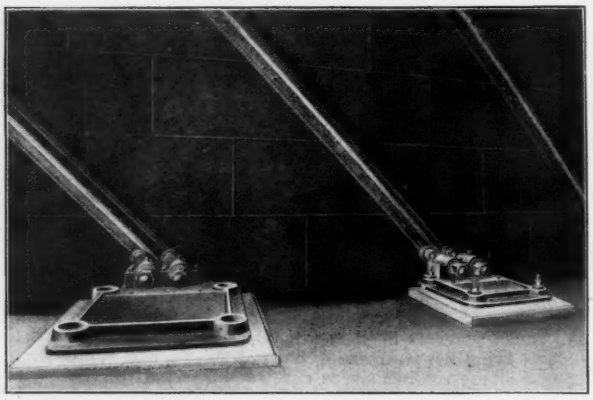
Among the many advantages that are claimed by the Glover-West system of carbonization, the following may be mentioned: Increased make of gas per ton of coal carbonized. Larger yield of gas made on a given area. Constant illuminating power and calorific value, and uniform composition of the gas throughout carbonization. Low percentage of inert gases. Coke of improved value. Increased value of fluid residuals. Tar low in naphthalene and free-carbon content. Low naphthalene content of gas. Utilization of the heat from the residual coke. Low consumption of fuel for heating the retorts. Complete control of the heat. Absence of smoke, dust, and steam nuisances, and, therefore, better conditions for the men employed. Less arduous labour. Lower working costs. Simplicity and complete control of the discharging apparatus, and the ready adaptation of the plant to suit the different classes of coal. Regular coal feed. Regularity of output of gas, with consequent increased efficiency of the purifying and condensing plant.

THE SPIRAL-GUIDED GASHOLDER AT BELFAST.

The Spiral-Guided Holder.

This gasholder, though in itself not of a new design, still possesses novel features which have probably been built in connection with a holder of this size for the first time. The problem of increasing the storage capacity on the present site could only be solved by putting extra lifts on existing holders, or pulling out worn-out holders, and erecting in their stead new holders with more lifts. The first of the holders to be so treated was a two-lift one, 180 feet diameter in the outer lift, with a total height of about 62 feet when inflated, and contained in a brick tank. The total capacity of this holder was 1½ million cubic feet.

The new holder has also an outer lift 180 feet diameter; but the four lifts, when inflated, would stand a total height of 124 feet to the edge of the crown, and give double the capacity of the old holder—viz., 3 million cubic feet. The novel features referred to are very much improved means of guiding and controlling the various lifts. Until very recently the general practice was such that each rail engaged with two rollers mounted on steel axles, and attached to a cast-iron or steel carriage bolted to the dip or tank edge, according to the position of the rail engaged. The guiding-devices of the present holder consist of four rollers in two pairs for each rail, each pair of rollers being connected together by a steel yoke, having a very strong axle; the two axles being fitted to a strong cast-iron carriage bolted to the dip or tank. The adoption of this carriage enables the guide-rails on the lifts to be under control at four places, instead of two as heretofore, thereby



THE SPIRAL GUIDE-RAIL, ROLLERS, AND BED-PLATES.

distributing the work on the rails, while in both upward and downward strains the twin rollers are operative. These rollers are also provided with sliding axles, having Stauffer lubricators that effectively provide for expansion and contraction.

Another novelty in connection with the holder, so far as the Belfast works are concerned, is the device for preventing water overflowing indiscriminately down the sides—such water, with its accompanying dirt, in the old style of gasholder building, having the effect of destroying the sheeting and spoiling the painting with streaks of dirt. In this holder the top side sheets of each lift are carried up about 3 inches above the edge of the dip or curb, and cut away on one side of each rail in such a manner that any overflow from the crown or cups runs down the side of the rail to the cup or tank below. This device itself will save the necessity of painting the holder as often as it would otherwise require doing; and on a holder of this size the painting is a considerable item, though much less than on the guide-framed type. The guide-rails are made by special rolls, and have been designed for the maximum of convenience in attaching to the holder sides, combined with strength and grip for the rollers.

The existing holding-down bolts were re-used; a special bed-plate being adapted to meet their requirements. Extra intermediate holding-down bolts were fixed without interfering with the tank-wall in any way. The bolts nearest the holder are secured on the inside face of the wall, being suitably protected against corrosion; while the back bolts were fastened to the back of the existing brickwork in a similar manner. This obviates any risk of leakage in the tank through alterations to the wall.

The illustration of the holder has been taken over the crown of the spiral holder that was erected at Belfast twenty years ago, and has been in constant operation since. Though in the picture it looks comparatively small, it has a capacity of upwards of 76,000 cubic feet of gas. This holder, it is understood, was one of the first to be erected with exterior rails; and the great progress made in the construction of spiral holders may be observed by comparison between the two.

The whole of the work has been designed by the Engineer to withstand a wind pressure of 56 lbs. per square foot of exposed surface; and when one considers that the generally accepted wind force in this country is 40 lbs. per square foot, it will be evident that the holder is sufficiently strong to withstand any strains that are likely to be brought to bear upon it.

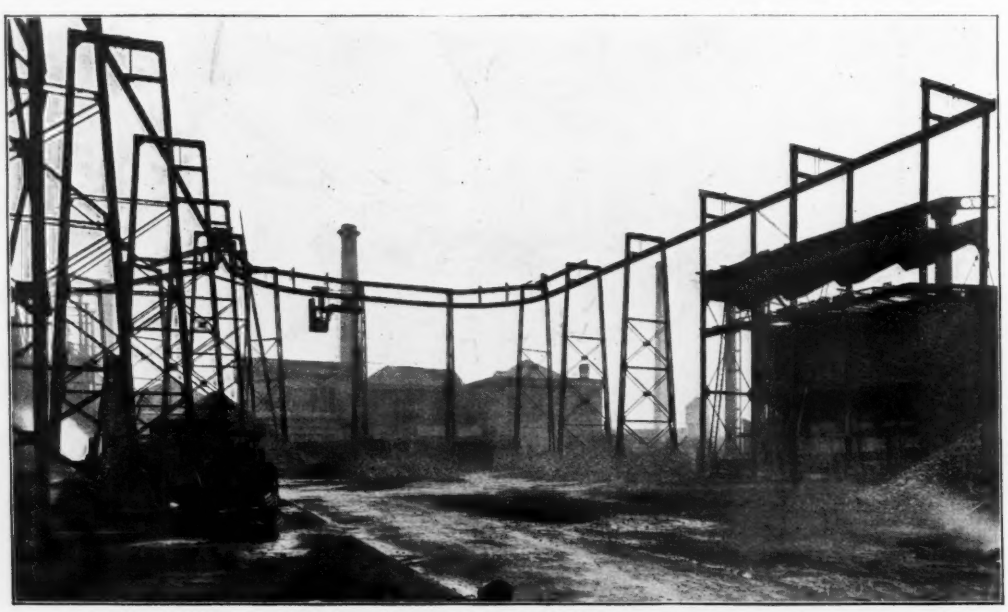
The Telpher Plant for Coke-Handling.

For handling and stacking the coke, an electric telpherage plant is installed on the well-known mono-rail principle. The plant is arranged to handle the coke from a pit at the end of the retort-house, from which it hoists the same, and conveys it to any position in the yard for storage, or to hoppers over the water-gas plant, and also to a large range of storage-hoppers fitted with propulsion screens.

The telpher track is arranged so that the telphers can run in a complete circle, with a spur or branch track to the hoppers at the water-gas plant. The total length of the track is 675 feet—being 193 feet on the long side, and 90 feet in width. The total height of the track above the ground-level is 48 feet, which will allow of coke being stored to a height of 30 feet over the whole area, if desired. The track consists of 15 in. by 5 in. rolled steel joists, with a stiffening channel bolted on top to give horizontal stability; and the actual running rail is bolted on the top of the channel by means of hook bolts, so that the track is easily renewable when worn. The track is supported at intervals of about 25 feet by substantial lattice trestles. These trestles are made up of steel angles, with steel web-plates between, extending to a height of 17 feet; and above them the angles are braced by flat steel bracing. Substantial bracing is arranged between trestle-legs, consisting of horizontal angles and diagonal bracing angles. The trestles are bolted to substantial concrete foundations.

Owing to the telpher track passing over the site of an old gas-holder tank, which had only recently been filled up, it was necessary to provide special foundations for the trestles. The Gas Department drove single piles into the made-up ground under the position of each foundation centre, and arranged the concrete blocks on top of the piling. The corners of the track are arranged with three curves of 25 feet radius, and one of 18 feet radius; and for the purpose of additional supports on the curves, overhead cross joists are arranged from which C-shaped steel hangers are attached, giving additional support to the track between the trestles—these hangers being spaced about 9 feet apart. The track-joist is bracketed off one leg of the trestle, by means of a joist track-arm; the outer end of the track-arm being slung from the top cross joists of the trestles by means of slinging bolts. These bolts are adjustable, so that the track can be levelled-up accurately.

Where the branch or spur track is arranged, the track is fitted with Mitton and Dempster's patent tumbler switch. It is so arranged that the continuity of the circular track is not broken when the switch is thrown over; the switch section, which is about 10 feet long, being mounted on a heavy central spindle, which is bolted to the web of the track-joist. The spindle, which carries the switch, is rotated by means of a worm and worm wheel; the continuous track being bolted on to the top side of the switch joist, so that when it is in this position the telpher can continue to run round the continuous track. The track to the spur or branch line is bolted on to the underside of the switch. When this is rotated, the passage of the telpher is diverted to the branch line. The switch is operated by means of a chain and chain wheel from a platform on the trestle, and can be so arranged that only the telpher driver himself can change the switch over. This arrangement prevents any interference of the switch and the telpher driver over-running without having knowledge that the switch is open. Two lines of overhead trolley wiring are fitted to the underside of the top-joists to the trestles; the wire being of

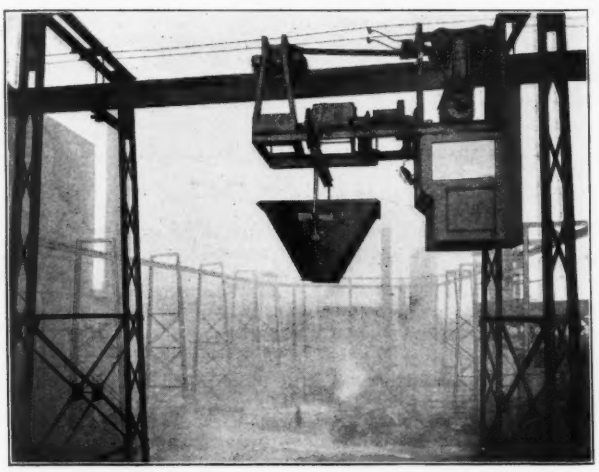


THE TELPHER TRACK ROUND THE COKE-YARD.

figure 8 section, attached by means of mechanical clips to special insulators.

The current supply, which is at 440 volts, is provided by the Belfast Corporation Electricity Department, who have supplied special cables terminating at a switchboard furnished by the Gas Department. This switchboard (which is enamelled slate) is provided with the necessary ammeters, voltmeters, automatic cut-outs, switches, and fuses, and furnishes the necessary circuits to the telpher and other plant electrically driven on the works; the switchboard being of the most complete and up-to-date design.

There are two complete electric telphers provided, which are of Messrs. Brooks and Dempster's patent swivel bogie design. Each machine is suitable for hoisting a gross load of 60 cwt. at 80 feet per minute, and travelling at a speed of 500 feet per minute. The machines consist of a rigid steel frame, which carries the hoisting gear, driver's cabin, &c.; and this steel frame is mounted on swivel bogie trucks. Each swivel bogie is provided with a pair of manganese travelling wheels; the wheels being mounted on steel spindles revolving in Hyatt roller-bearings.



THE BROOKS AND DEMPSTER PATENT SWIVEL BOGIE ON THE TELPHER TRACK.

Down the side of one of the bogies is fixed a steel casting, from which the travelling motor is slung. The two travelling wheels on this bogie are driven from the motor by means of Hans-Renold silent link chain; so that as the bogie swivels, the driving motor and chain swivel with it. Both of the bogies are so arranged that the rigid frame is pivoted on the top; the bogies themselves being free to turn on the centre, to allow of the machine travelling easily round curves. The bogies also are arranged to rock laterally, which ensures the travelling wheels always being in close contact with the track, and taking a proportion of the weight of the machine—thus obviating any tendency to skid when running in wet weather.

The hoisting gear consists of a Siemens motor, driving the main hoisting shaft through a set of reduction gear. An automatic magnetic brake is fixed on the motor-spindle, to automatically hold the load should the current fail, or when the current is shut off. The countershaft is also provided with a substantial band brake, which is controlled by hand from the driver's cabin. The hoisting-drums are provided with machine grooves to suit the hoisting ropes. The machines are fitted with two hoisting ropes, each about 80 feet long, and each rope having a breaking strain of about 9 tons. The driver's cabin is fitted to the underside of the main frame. This cabin contains the electric controller and resistances, and also a pedal-operated brake to the travelling wheels, a hand brake for the hoist-drum, and a small lever for releasing the electric brake on the hoist-motor.

A single controller is arranged to operate either the hoisting or the travelling motors. Current is transmitted to either by means of a change-over switch. Main switch and fuses are also fitted, so that the machine can be entirely isolated from the driver's cabin, if desired. A large bulkhead light fitting is arranged on the front of the cabin for showing on to the load when hoisting; and a small fitting is provided inside the driver's cabin to light up the place. The cabin is constructed of timber panels, and is fitted with windows all round, so that a view can be obtained in either direction; and a sliding door is also fitted at the front of the cabin, so that the driver is entirely protected from the weather. The current is collected from the overhead trolly wires by means of two wheel-head collector trollies.

A tipping cord is provided on the telpher, which is so arranged that it is wound up by means of counterweights when the skip is hoisting, and is automatically paid-out when lowering. The cord passes through the driver's cabin, so that the driver can, by pulling on the cord, release the tipping-catch on the skip, and tip it with the load hoisted any height desired. Each telpher is equipped with a suitable coke-skip having a capacity of about 25 cwt. of coke; these skips being constructed of steel plate, stiffened with steel angles. The skips are so balanced that they are self-tipping when full, and self-righting when empty. The skips are lowered into a pit; and the coke is discharged into the skip from the hopper. The pit is so arranged that a skip can be dropped on either side of the conveyor; and one skip can be filling while the telpher is handling another.

For the storing of the coke, a range of coke-hoppers has been provided; the hoppers being 40 feet long, 25 ft. 6 in. wide, and 15 feet deep, constructed of steel plate and steel angles. The lower portions of the hoppers are coned, and fitted with slide doors with operating gear. At the bottom of the cones are also provided hinged bagging shoots; so that, when desired, coke can be discharged direct into bags. The hoppers are supported by a substantial structure, consisting of steel joists with the necessary bracing, &c. On the top of the hoppers, which are at right angles to the run of the telpher track, four patent balanced jigging-screens are provided for sizing the coke, and delivering it into the various sections of the hopper. These screens are driven by means of two of Siemens Bros. 10-H.P. totally enclosed motors. A central hopper is arranged directly under the telpher track, into which coke is discharged from the telpher skip; this hopper being arranged by a suitable feed to deliver on to screens, on top of the hoppers, for dealing with the coke.

Steel hoppers are provided for the water-gas plant; these hoppers being 14 feet by 14 feet by 8 ft. 6 in. in depth, and formed of steel plates, stiffened by steel angles. They are provided with slide doors and operating gear; and on one side a set of bar-screens is arranged for screening the small coke. The hoppers are supported on a suitable structure, consisting of steel joists, with the necessary bracing.

The whole plant is one of the most complete of its kind in the United Kingdom, and was manufactured and erected by Messrs. Robert Dempster and Sons, Limited, to the general design and specification of Mr. J. D. Smith.

THE MANUFACTURE OF MANTLES FOR INCANDESCENT GAS LIGHTING.

By Dr. C. Richard Böhm, of Berlin.

(*Concluded from p.* 101.)

Collodionizing the Mantle.

As soon as the mantle has been burnt off and hardened, it can be placed on a burner for use. But, as it is still very brittle, it cannot be transported in this condition. Only after the ash skeleton has been stiffened by covering it with a collodion solution does the mantle receive the resisting qualities which fit it for transport even across the seas. The so-called "dipping fluid" is composed of gun cotton dissolved in ether, with small quantities of castor oil and camphor added to it. A good dipping fluid should not be too thick, and is required to impart a certain amount of hardness to the mantle. It should further cause as little contraction of the mantle as possible, and cover its meshes with a glossy coating. It must not dry to a gummy consistency, and should burn off entirely and with the least possible odour. Many years of experimental work were required to reach the present state of perfection, when it is possible without very much trouble and loss of time to compose a dipping fluid suitable for the various types of mantles.

Most mantle manufacturers, instead of using the convenient ready-made dipping fluid, buy the collodion solution (generally obtained from 4 per cent. collodion cotton) separately, to which they add the necessary quantities of camphor, &c. Considering the great variety of mantles and the demand as to thickness of coating, strength, &c., which vary with varying conditions, it is, of course, impossible to give a recipe for use in all cases. The composition given below must, therefore, only be taken as a guiding principle, subject to the necessary alterations to be made to adapt it to special requirements.

100	parts of	4 per cent. collodion solution.
40	,,	,, ether.
6·5	,,	,, camphor.
3·5	,,	,, castor oil.

By using this fluid, a well-stiffened mantle with a medium coating is obtained.

Even after having been collodionized, the mantle continues to be sensitive to pressure and knocks, although the result of such treatment is not noticed until the coating has been burned-off, when cracks begin to appear. Lately it has been attempted to get rid of this drawback by adding to the collodion inorganic salts, such as the nitrates of thorium, zirconium, or beryllium.

"Securitas," "Lederstrumpf," "Pergament," &c., are some makes treated in this manner.*

The mantles are collodionized in batches of ten or more, which, suspended from a rod or carrier, are simultaneously dipped into the fluid contained in an earthenware or tin trough, and then they are placed in a heated chamber or box to dry. The temperature at which the drying takes place should not be too low, for the slower a mantle dries the longer does the strain last which the not inconsiderable weight of the wet collodion puts on it. Therefore, a quick drying at a temperature of from 50° to 60° is to be recommended.

Until quite recently, considerable difficulty used to be experienced in the collodionizing of mantles made from artificial silk—a specially composed fluid being required for the purpose. In France, where mantles are furnished with so-called frames to be fixed on the burner, those made of artificial silk are still sent out uncollodionized. In spite of this, next to no breakage takes place in transit, owing to the great elasticity and strength of this type of mantle. The quantity of dipping fluid required varies between 4 and 6 kilos per 1000 mantles, according to the greater or less viscosity of the collodion and the texture of the web. A female worker, receiving from 12 to 14 marks weekly, is able to collodionize 7000 to 8000 mantles of standard size, burnt-off by hand, or 10,000 to 12,000 of the same kind burnt-off on machines, provided dipping apparatus of modern type is employed.

Trimming the Mantle.

As has already been pointed, the raw stocking has always to be cut somewhat longer than the size which the finished mantle is required to be, in order to allow for shrinkage during the burning-off and hardening processes. Frequently, a batch of uniformly treated impregnated stockings will, after they have been burnt off, show great variety as regards shape, length, &c. Another fact to be considered is that, inasmuch as the stockings are cut from web manufactured in lengths, the rows of meshes at either end are liable to become loose, and, in the hand of a not too careful worker, come undone. Consequently, the collodionized mantle also shows these undone meshes very distinctly at its lower end. For this reason the mantle, by a trimming machine, is cut down to the required length, whereby all irregularities are removed.

A highly-skilled female operative receiving a wage of from 12 to 14 marks per week, can, with the aid of a device of simple construction, trim between 5000 and 6000 mantles per day. It is evident that, by using a multiple of cones and by working the machine by foot, a relatively larger output can be obtained. With Killing's machine, for instance, from 7000 to 8000 mantles can be trimmed per day. In case the mantles are to be examined and boxed by the same hand immediately after trimming, only from 3000 to 4000 per day can be turned out by a single person.

Sorting Mantles—Flaws and How They are Caused.

As already stated, hardly two mantles turn out alike, owing to the peculiarities of the process of manufacture. It is, therefore, imperative that all mantles, after having been collodionized and trimmed, should be closely examined and sorted. Of course, this scrutiny can be conducted from different points of view; there being, first, the question of shape and, secondly, that of diameter at a point about $\frac{5}{8}$ inch or $\frac{3}{4}$ inch from the bottom of the mantle, to facilitate a proper fit when placed on the burner. Apart, however, from these considerations, attention should be paid to the fact that mantles show not infrequently little specks and holes. Naturally, the percentage of "seconds" is great or small according to the greater or less amount of conscientious care with which the sorting is carried out.

It is taken for granted that, throughout the manufacturing process, the production of mantles of first quality only has been the guiding principle. For it is impossible to detect all the inherent faults of a mantle by simply looking at it. Only in the burning do these faults reveal themselves—in the form of decreasing illuminating power, formation of a waist, or by the asbestos loop becoming brittle and eventually giving way. Where the manufacturer has used web of an inferior quality, or did not bestow sufficient care upon the washing process, or else has been too sparing in the use of the expensive thorium nitrate, with the result that the stockings have been but insufficiently impregnated (which mistake cannot be made good by adding hardening ingredients) the mantles thus produced will only reveal their real nature as "seconds" after having been placed on the burner and taken into use. As regards the asbestos loop, the manufacturers cannot in every case be made responsible for its becoming brittle and breaking away, because, even by using the best quality of asbestos, no guarantee against such happenings is possible.

To recapitulate, the faultless shape of a mantle, and the fact that its opening at the head and its diameter $\frac{3}{4}$ inch from the base are according to regulation, form no guarantee whatever as to whether it is a "first" or a "second." However, the manufacturer should know his products and, consequently, be able in the sorting process to go by outward signs. From every batch intended to yield mantles of first quality, a certain percentage of "seconds" and waste will always be found to result. A difference as regards diameter does not of necessity stamp a mantle as a "second," in view of the fact that there are many different types of burners with tops of varying diameter. Consequently, the manufacturer will take care to sort the mantles, according to their varying width, for use with different types of burners. This, however, is only possible if the stocking has not been stamped with a trade mark, &c. In the event of a stamp having been applied, such mantles will, without hesitation, have to be condemned as "seconds," as the manufacturer would otherwise bring discredit on the special brand bearing his trade mark.

Mantles which by one maker are considered of first quality will by another be classed among "seconds." It is difficult to lay down hard-and-fast rules in this respect. So far as mantles showing actual faults—for instance, holes and spots—are concerned, they should straight away be classed among "seconds;" but as regards differences in diameter and shape, it will often be found difficult to decide whether a mantle should be called a "first" or a "second."

Sometimes the manufacturer of incandescent mantles will come across defects the cause of which he is at a loss to understand. In this industry, it is not an infrequent occurrence that the defects arising in the course of making become only apparent at such a late stage that the manufacturer is quite unable to trace them back to their origin, especially as in the meantime such defects have generally been superficially removed to such an extent as to be hardly visible to the eye. It might, therefore, be of interest to name the causes underlying the defects most frequently met with. As regards those referred to under Nos. I., II., III., and IV., a flame of even temperature and one fed at a constant gas pressure has been taken as a standard in making the necessary observations.

I.—Variations in the width and length of mantles are caused by:

- (*a*) The use of yarn of varying strength.
- (*b*) Uneven impregnation.
- (*c*) Differences in the size and shape of the wood blocks.
- (*d*) Careless and uneven shaping of the stocking on the wood block.
- (*e*) The web being unevenly stretched when drying.
- (*f*) Differences in the number of rows of meshes per cm. and differences as regards number of needles employed.
- (*g*) Differences as to the size of the head opening.

II.—The forming of a waist must be ascribed to the following causes:

- (*a*) Chemical impurities. In view of the fact that the addition of other substances to the fluid tends to harden the mantle, and that it is a common practice among manufacturers to make such additions in order to impart greater strength to the ash skeleton, the formation of a waist would be avoided, if the temperature of the flame were uniform at all its different points. This, however, is not the case, as the shape of the flame is conical, and the greatest heat is developed at the widest part of the flame—just at the part which comes into immediate contact with the mantle and, consequently, would easily cause the formation of a waist were it not for the fact that a uniform upward and downward movement of the burner is generally assured.
- (*b*) A combination of two or more of the causes enumerated under I. This, however, is of extremely rare occurrence.

III.—Causes of the various defects in the formation of the head:

- (*a*) Protrusions below the head are caused:
  1.—Through an uneven distribution of pleats.
  2.—Through failure of following the same row of meshes when cutting the web.
  3.—Through sewing the asbestos thread unevenly.
  4.—Through the asbestos loop not crossing the head in the middle.
- (*b*) The breaking off of the head is caused:
  1.—Through the asbestos thread being inserted too near the top end of the web.
  2.—Through the hardening fluid being too weak or through not having been applied in sufficient quantity.
  3.—Through a one-sided application of the flame to the moist head. In this case, the latter usually breaks away at the spot where the flame first touched it.
  4.—Through the web sticking on to the burner.
  5.—Through the head not having been sufficiently hardened on the compressed gas-burner.
  6.—Through lack of care in collodionizing—*i.e.*, if the time allowed for the collodion to properly soak itself into the head is insufficient. In this case, the weight of the superfluous collodion tends to weaken and tear the mantle at the head.

IV.—The thin and glossy spots often observed in mantles are the result of:

- (*a*) The web having been besprinkled with water.
- (*b*) Too wet impregnation.
- (*c*) The web having been handled with moist hands due to perspiration (an alkaliferous influence).
- (*d*) The web having been brought into contact with a fixative. The action of alkali as well as of the component parts of the fixative cause an easily fusible skeleton to be formed showing the glossy spots referred to.

* See Böhm, 1 c., pp. 351-53.

V.—Holes are caused through:
(*a*) Grease spots in the raw web. They have to be rather pronounced to be able to cause any damage.
(*b*) Asbestos fluff sticking to the web.
(*c*) The impregnating fluid having been too weak.
(*d*) Alkaliferous impurities in the web, generally introduced through handling it with perspiring hands; it being a well-known fact that perspiration is strongly alkaliferous.
(*e*) Small particles of rust or other mechanical impurities contained in the gas, which, when thrown against the sensitive ash skeleton, are liable to pierce it.
(*f*) A wrong mixture of gas and air, causing irregularities in the flame produced, accompanied by explosions in the burner. Mantles treated with a weak impregnating solution are thereby liable to become damaged in two opposite places.
(*g*) The causes given under No. IV., which are responsible for the thin and glossy spots.

VI.—Causes of deformities.
(*a*) Entire malformation of the mantle is caused through:
1.—Unevenness in the impregnation. However, the same defect is liable to occur with mantles which, although impregnated quite evenly, have been placed in a moist condition upon dry wood, paper, cloth, or a similarly effective absorbent. Such mantles will naturally shrink in the burning-off more than they would have done under proper conditions.
2.—Distortion of the web, owing, for instance, to uneven shaping on the wood block or glass cone.
3.—Draught during the burning-off process.
(*b*) Partial irregularities in the mantle are caused through unevenness of the yarn.

VII.—The causes of spots are:
(*a*) In the case of reddish-brown spots, iron;
(*b*) In the case of brown spots, stamping fluid (didymium).

Holes in the mantle, which sometimes show themselves in large numbers, are a source of great annoyance to the manufacturer. The fact that all holes tend to increase in size very rapidly, and that they allow the flame to pass outside the mantle, whereby a fusing and breaking of the chimney is not infrequently caused, would suffice to condemn all mantles showing holes to be put among "seconds," or thrown on the waste heap. Some manufacturers put such mantles among "seconds" without first "doctoring" them. But then there is a certain kind of luting by means of which the holes can be stopped up. Since the very inception of the mantle industry, the medium used for this purpose has been a paste consisting of oxide of thorium and ordinary collodion.* Mantles "doctored" by such means are by all high-class firms sold as "seconds," for export; while the less scrupulous manufacturer does not hesitate to mix them with mantles of first quality. It should, however, be known that holes thus repaired will not permanently remain closed after the mantle has been burnt off and taken into use. Thus the damage is only superficially repaired, and the consequences are sure to show themselves after a short while.

A girl or woman, receiving from 14 to 15 marks per week, is able to sort between 4000 and 5000 mantles of standard size per day. In America, wages are twice as high as with us—from 8 to 10 dollars (*i.e.*, 32 to 40 marks) being paid; while with us the minimum rate is 12 marks, and the maximum 20 marks.

Packing.

Nowadays mantles for upright burners are almost universally packed in tubes—*i.e.*, cardboard boxes of cylindrical shape, with a lid at either end. Slight incisions are not infrequently made at two opposite points of the top end of the box for the purpose of fixing the piece of cotton on which the mantle is suspended. Usually both lids are lined with cotton wool, which serves as a kind of cushion in order to protect the mantle against damage. This precaution is chiefly required for the protection of the very sensitive head.

With the introduction of inverted mantles, new difficulties presented themselves, not only respecting manufacture but also with regard to packing. If the upright mantles fitted with metal or magnesium heads demanded greater care in packing as compared with the ordinary upright, much more so the inverted mantle, on account of the comparatively heavy magnesium ring. For the purpose of fixing the mantle in the box, the latter had to be provided with a ledge or inner ring on which the outside protrusions of the ring might rest. This mode of packing renders the placing in, and taking out, of the mantle an easy matter, at the same time preventing any shifting of it in transit. To arrive at this result seems to have been no easy matter, to judge from the number of designs of boxes for which patents have been granted.

* A German patent No. 149,057 of Feb. 21, 1903, was granted to J. Werthen for the process, but was cancelled owing to non-payment of the patent fee for the second year.

ACETYLENE AND PETROL AIR GAS.

Papers read before the Illuminating Engineering Society.

There were two papers of considerable length read on Tuesday last at the meeting of the Illuminating Engineering Society—the first on "Acetylene Lighting," the second on "Petrol Air-Gas Lighting." The former was by Mr. C. Hoddle, and the latter by Mr. E. Scott-Snell.

ACETYLENE LIGHTING.

The paper by Mr. Hoddle commenced with a reference to the one read by Professor Vivian B. Lewes in 1895; and there was contrast between the position of the acetylene industry then and now. Next followed a description of the process of generating acetylene from calcium carbide. The carbide may be placed in water or water poured on to the carbide. The author commented on the number of different ways of performing this simple operation that have been patented during the past ten years. He himself has contributed to swelling the shoal of inventions. Mention was made of the fact that acetylene, as it first leaves the generator, is not suitable for house-lighting purposes, as it contains a small percentage of phosphoretted and sulphuretted hydrogen. In generators that wash the gas, the sulphur is sufficiently removed by the water; but separate purifying apparatus is necessary to remove the phosphorus. Otherwise it will pass through the flame, and cause a smoky haze in the room. Such impurities emit an objectionable smell; and, according to some authorities, also lead to the choking-up of the burner.

One point in connection with the storage of carbide may be noted. Large quantities are invariably stored in sealed tins, as the effect of moist air in contact with carbide would naturally be to cause a slow liberation of acetylene and gradual deterioration of the material. Recently the plan has been adopted of compressing carbide into "briquettes," which are coated with some material rendering them inactive to air. This special carbide possesses the quality of preventing "after-gassing"—*i.e.*, the gradual liberation of acetylene after the tap has been turned off. But its gas-yield cost is, roughly, four times that of ordinary carbide; and its use is therefore restricted to special purposes.

Burners.

There was next a reference to the development of acetylene burners; and Mr. Hoddle mentioned the Bray "Elta" and "Ota" as two typical varieties used mainly for house lighting. One of his asides was that Messrs. Bray now employ upwards of 500 hands for the making of acetylene burners alone; and they use upwards of 50 tons of carbide a year for burner-testing purposes only. Acetylene burners, it is claimed, should, with proper treatment, last a very long time. Mr. Hoddle knows of a house in which many of them have been used for seven years, and are still doing good service. The range of consumption ordinarily employed varies from $\frac{1}{8}$ to 1 cubic foot, the corresponding candle-power being about 10 to 50. The pressure recommended is usually about 4 inches (water). The author does not favour the use of incandescent mantles with acetylene. The gas orifice of the burner is so small that, sooner or later, a bit of grit or dust will partially choke it; and the correct bunsen flame is upset. The mantle becomes a black mass, and then—well, the less said the better. But, really, there is no need for mantles. "We have already a splendid pure white light, which we consider resembles daylight very closely; and we can obtain about 40 candle power for a consumption of 1 cubic foot of gas per hour, which means (at the present price of calcium carbide—*i.e.*, 13s. 6d. per cwt.), approximately 7d. per 1000 candle-hours."

Costs.

Some details were given as to the cost of lighting an average country house by acetylene, assuming that such a house requires fifty lights, giving a total candle-power of about 1000 with two-thirds of the lights on. In these circumstances, the running cost would amount to about 7d. per hour. If the majority of the lights are used on an average three hours per night, the cost of carbide per year would be about £30. The total cost of installation, including the general average fittings, the piping, and everything, should not be more than £100. The generator installed in a moderately big house of this kind would probably be of the twin type, which enables one section of the generator to be used while the other is being re-charged. The charge in the two generators would keep the lights going for eight hours (assuming, as before, that only two-thirds of the lights are going at once).

Regarding portable flare acetylene lamps, these will burn for six hours, consuming 12 lbs. of carbide in doing so. The estimated light is approximately 1000 candle power. A rough rule is

that four flares of this type are required so as to illuminate every 1000 square feet.

Colour, Safety, and Intrinsic Brilliancy.

It was claimed by the author that the colour of the acetylene light closely resembles that of daylight. Then he discussed the question of safety. He considers that no artificial illuminant could well be safer. An explosion, he says, cannot take place with less than 3 per cent. of acetylene, which would mean that in a small room of, say, 10 ft. × 10 ft. × 10 ft., or 1000 cubic feet air-space, 30 cubic feet of acetylene would be required (or 6 lbs. of carbide would have to be dissolved) to get an explosion. In other words, a 1-foot burner would have to be left full on for 30 hours to get an explosive mixture, even if the room was sealed air-tight. In the meantime, the smell would become unbearable. Of course, he is aware accidents have occurred; but he thinks he is right in saying that nearly every one has been caused by amateur-made plants and compo-pipe installations.

Safety in illuminants is certainly very important. But there is another point that Mr. Hoddle says should appeal strongly to members of the Illuminating Engineering Society, and that is the effect of the light on eyesight. He is of opinion that it will be admitted that acetylene is in a fortunate position in this respect. The tendency for some years has been to make lights more and more brilliant and glaring; and, therefore, methods of shading are in many cases absolutely essential. "But the acetylene flame has only a mild luminosity; so that it can be gazed at without the eye being conscious of any discomfort. This is one reason why the light has proved to be very serviceable for fine work, embroidery, &c.; and its whiteness is also an advantage when delicate shades of colour have to be distinguished."

Dissolved Acetylene.

Dissolved acetylene has been rendered possible mainly by the use of liquid acetone which, at a pressure of 10 atmospheres, and at a temperature of 15°, can absorb as much as 240 times its own volume. When this pressure is released by opening a vessel saturated with acetylene in this way, the gas is evolved, because the liquid cannot absorb nearly so much at ordinary atmospheric pressure. Dissolved acetylene outfits are in very convenient and portable form. The smallest size of cylinder in general use will store about 6 cubic feet of acetylene; the cylinder being about 1 foot long and 4 inches in diameter. Larger cylinders, with a capacity up to 100 cubic feet, are available. The advantages of dissolved acetylene lighting are its convenience, and the fact that tubes containing dissolved acetylene can be so readily carried about from place to place, and turned on at any time. Naturally, dissolved acetylene is more expensive than gas produced from a generator in the ordinary way—costing, in fact, about five times as much to the ordinary consumer. This restricts its use for general purposes.

A Self-Contained and Portable System.

Another great advantage of acetylene is its self-contained and portable nature. This advantage comes out very clearly in emergency lighting; for example, for illuminating docks, roadway alterations, buildings in course of construction, and tramway and railway work. As an illustration of the use of acetylene for remote railway stations, Brockenhurst Station (London and South-Western Railway) was cited. This is lighted throughout by acetylene; 200 burners, with a total of 9000-candle power, in all being employed. All the lamps are furnished with gas from a single central station; the platform burners consuming 1 cubic foot per hour, and the signal-light burners ¼ cubic foot per hour. The author referred to several other uses of the light—such as for mining and motor cars. It can, he claims, also be used quite successfully in stoves for cooking and heating purposes. There is further oxy-acetylene welding and cutting, in connection with which dissolved acetylene is largely used. One of the most useful purposes to which acetylene will shortly be put is the cinematograph. A mixture of acetylene and oxygen, used on a special disc of ceria, gives a light almost equal to the electric arc. [Mr. Hoddle showed this light in operation.] Ordinary lime burns away so rapidly that it cannot conveniently be used in the intense heat of the oxy-acetylene flame; but the ceria discs last quite a sufficient time. The candle power immediately opposite the incandescent disc is about 1100—a value which it would be difficult to attain except by the electric arc. The light is concentrated over a small area—the entire disc being only 22 mm. in diameter, and the incandescent portion smaller than this. The lamp consumes about 7 cubic feet per hour of approximately half-and-half mixture of oxygen and acetylene.

PETROL AIR-GAS SUPPLY.

In his paper, Mr. E. Scott-Snell began with an elementary account of the principles of petrol air-gas production, and ended with some theoretical and technical information. In the prefatory part of it, he incidentally referred to the question of safety. He pointed out that liquid petrol only exists in the plant itself in the outhouse. The pipes led into the house contain only a mixture of air and petrol vapour, and the percentage of the latter is invariably small—1½ to 6 per cent. The system can therefore be claimed to be very safe when properly designed; for it would hardly be possible for a leakage of petrol air-gas to give rise to serious danger—over 94 per cent. of the escape being pure air. On the other hand, it must be borne in mind that petrol air-gas is not a true gas, but only a mixture of certain volatile hydrocarbons with air; and some of these hydrocarbons may condense if a wrong mixture, or an imperfectly designed form of plant, be employed. These difficulties, however, should never make themselves felt in the case of a well-designed system.

Regarding Efficiency.

As to the prospects of the system, the incandescent mantle has put a new complexion on them. Petrol gas has come to stay as long as there is petrol available; and to-day it is considered to be "one of the cheapest, most brilliant, and probably the safest means of lighting where neither gas nor electricity mains can be tapped." The fact that such a large proportion of air is taken into the burner through the pipes enables one to obtain, at the comparatively low pressure of 1½ inches, conditions of combustion comparable with those obtained by high-pressure gas. The natural result of the favourable conditions for combustion is that the size of inverted mantle commonly used for petrol air-gas lighting (that is to say, the bijou type) yields a much more brilliant light than would be obtained with corresponding mantles and low-pressure coal gas. Some tests recently carried out at the works of County Light, Limited, showed that some new mantles were giving 70 to 80 candle power, while others in the show-room that had been in use for some hundreds of hours, were still giving 48 to 50 candles. These tests were made on the mantles alone, without any form of shade; and the values quoted are practically equivalent to mean lower hemispherical candle-power. Petrol air-gas lighting can, of course, be applied to either inverted or upright burners; but the type that is most widely used is the inverted bijou. Used with the County plant, such burners are guaranteed to consume not more than $\frac{1}{90}$ gallon of petrol per hour; but, as a matter of fact, the consumption is often considerably less than this. On the basis of the figures mentioned, and the present outrageous price of petrol, the cost of petrol air-gas lighting per 1000 candle-power hours should not exceed 3d. to 4d. One might suppose that for factory lighting and industrial illumination generally, more powerful units would sometimes be useful. It is a curious fact that it is difficult to get the same high efficiency from larger mantles. "This experience will probably be confirmed by those who are concerned with coal gas lighting." At present, the usual course is to assemble a number of small units when a very powerful unit is needed.

Respecting the colour of the light, it should be almost exactly similar to that obtainable with high-pressure gas lighting, since the temperature is substantially the same. It has, however, undoubtedly less green in its composition than has the light from low-pressure coal gas mantles.

Defects—Avoidable and Otherwise.

The author next dealt with shades and fixtures, and then ran off on to the subject of the opportunities for the system. He remarked that there were good systems and indifferent ones. At the present time, there are probably between thirty and fifty different makes of plant on the market. Some of them are thoroughly trustworthy, and can be relied upon to work year after year, and give the consumer practically no trouble; but others are quite the reverse. It is very often found by consumers that the light is affected by the number of burners turned on, and that the illumination is very much diminished when the plant is run at its full capacity. This is sometimes due to the fact of piping in too small size being installed; but it is more frequently due to defects in the design of the plant, leading to variation in the composition of the mixture as more or less lights are turned on. It need not be said that this should not occur. Another defect that has revealed itself is the effect of temperature on the performance of a plant. Petrol air-gas is not a permanent gas; and it is possible that at low temperatures some of the volatile hydrocarbons may condense, especially if the degree of saturation is high. Condensation of this kind is a serious fault. If it occurs in the pipe leading from the outhouse in the open air, the action of the plant would, of course, be impeded, but no danger might occur. But the existence of liquid petrol in the pipes inside a house is a thing which is still more undesirable.

Giving some details of an actual typical petrol air-gas installation, the author mentioned that consumption figures kept by the owner show that his petrol tank is replenished with 6 gallons of spirit every ten days at the present time of the year—an average consumption of 0·6 gallon per night. From information given of the number of lights used during an average evening, this works out at a good deal over the ninety light-hours per gallon guaranteed by the County Light, Limited.

A rough rule for lighting interiors was given by the author. This assumes (as is frequently the case for industrial installations, though not always in country houses) that one wishes to produce a uniform illumination all over the room. It was found that in a room 10 feet square with fairly light wallpaper, an illumination of 4 foot-candles could be obtained at the working plane by two burners each consuming about $\frac{1}{100}$ gallon of petrol per hour. From this it is seen that, generally speaking, one-hundredth of a gallon per hour should yield $\frac{4 \times 100}{2} = 200$ lumens. From these data one might, perhaps, suggest a rule that 1 gallon of petrol per

hour should give, roughly, one hundred times this amount—*i.e.*, 20,000 lumens.*

Composition of Petrol Air-Gas.

The author proceeded to discuss in greater detail some of the points connected with the design of petrol air-gas plant. First, the composition of petrol air-gas was dealt with. The necessity of high flame temperature for mantle work was pointed out; and therefore, remarked the author, neither the fuel nor the air must be in chemical excess. If there is excess fuel, combustion will be incomplete; if excess air, there is a larger volume of gas than necessary sharing the heat units liberated. In each case the temperature falls short of the maximum. The examination led the author to the deduction that the heavier the spirit used, the larger the proportion of air necessary to burn it. He advocates the use of a gas containing at least 5 per cent. of vapour in its composition; for in the event of a flame by any means lighting-back into the pipes, it is immediately self-extinguished, instead of resulting, as has happened on several occasions within his knowledge, in a damaging explosion.

It must not be thought that the use of a "rich" mixture results in a heavier consumption than when a "poor" one is used. The gas required at the point of combustion—the mantle—must be that giving the highest temperature, and when a rich mixture is employed, dilution is effected locally by the use of injector burners with adjustable air-sleeves, instead of, as with a weak gas burning, the mixture at the end of a gauze-covered tube without the addition of further air. In each case the proportions consumed at the mantle are the same, as is the consumption of petrol for a given candle-power.

Although it is advisable to make a gas of at least 5 per cent. to secure immunity from internal inflammability, yet the upper limit of richness has to be considered. The objections to condensation in the pipes are obvious—*e.g.*, loss of calorific value, blocking of passages, and, in extreme cases, the dripping of liquid petrol from brackets and pendants in rooms. It is out of the question for practical or commercial purposes to make a rich mixture with other than the petrol known as "Swan" or "Anglo-Special," sp. gr. ·680 to ·695. With these petrols the author has never in practice found any condensation, even when pipes have run long distances out of doors in exposed positions. On the other hand, experimental work with a self-burning mixture made from ·670 spirit has shown condensation when passed through a coil surrounded by water drawn from a tap in the room. The conclusions arrived at, therefore, are that, where a rich gas is made, no spirit heavier than sp. gr. ·695 should be used; and if it is desired to employ commercial petrol (or that used in motors), it should not be heavier than ·710 or ·720; and it is essential then to use a self-burning gas. Such heavy petrol as that used in motor-buses and lorries (·760) should be avoided, for either a large amount will be rejected by the carburettor, or else, if the spirit is completely evaporated, condensation may be expected to a serious extent, except in artificially warmed positions.

Calorific Value.

The calorific value of members of the paraffin series included in the petrols may be taken as about 20,000 B.Th.U.'s per lb. As a matter of fact, there is a slight increase in B.Th.U.'s per lb. as the specific gravity gets lighter. It will be seen that, as the spirit is bought by volumetric measurement, instead of by weight, the heavier the petrol the greater the number of heat units per tin. For example, a gallon of light spirit would contain $6{\cdot}8 \times 20{,}000 = 136{,}000$ B.Th.U's, against $7{\cdot}6 \times 20{,}000 = 152{,}000$ B.Th.U.'s per gallon of "Crown" spirit. Were it not for the above-mentioned disadvantages attendant on the use of the heavier fuel, this would be a point well worth consideration.

Knowing, then, the make of gas in cubic feet per gallon, the calorific value of the gas is only a matter of simple calculation. For example, a 1·5 per cent. gas from ·720 spirit (1500 cubic feet per gallon) would have a calorific value of $\frac{7{\cdot}2 \times 20{,}000}{1500} = 94{\cdot}6$ B.Th.U.'s per cubic foot, and a 6 per cent. gas from ·680 petrol would have a calorific value of $\frac{6{\cdot}8 \times 20{,}000}{410} = 331$ B.Th.U.'s per cubic foot—"the latter figure comparing not too unfavourably with some specimens of coal gas."

The advantage of the rich gas is obvious when the carrying capacity of pipes is considered. The specific gravity of the two types not differing substantially, a given pipe is capable of carrying three-and-a-half times the value with rich gas as with the weak type, with the same fall of pressure in each case. In installations of the plant designed by the author, ¼-inch barrel, and even ⅛-inch barrel, is successfully used, whereas it will be found that weak gas plants seldom allow of any piping less than ⅜-inch.

Candle Power and Cost.

The question of the cost of light from petrol at the present time is one of great interest and a great deal of argument—firstly, because no two makers seem to agree upon a definite figure, such wide claims being made as from ½d. to 4d. per 1000 candle-power-hours; and, secondly, because the price of the petrol itself has fluctuated between excessive extremes. One point the author would insist upon, and that is, that the price of light from petrol must be a function solely of the price and value of the spirit itself, and cannot be influenced by the methods of its generation, given that the apparatus does its work efficiently, leaving no residue in the carburettor. Here one feels the need of some independent authority to fall back upon; the unbiassed information available being very scanty and incomplete.

Professor Vivian B. Lewes reports an efficiency of 5000 candle-power-hours per gallon; whereas Mr. O'Connor gives a test which reduces to about 6500 candle-power-hours per gallon. The author was present at a test giving 4500 candle-power-hours per gallon; while Mr. Strode issued a report which worked out at 6000 with one burner, and 9350 candle-power-hours per gallon with another—both with rich gas. In some rough tests recently made at the County Light Works, the candle-power of a burner with a new mantle, guaranteed to consume not more than $\frac{1}{30}$ gallon an hour, gave a maximum reading of 70 candle-power, which reduces to 6300 candle-power-hours per gallon. The average of all these figures is 6800 candle-power-hours per gallon. With petrol at the famine price of 1s. 9d. net, this is only 3·1d. per 1000 candle-power-hours. The light obtained from different fuels is proportional to their calorific values. For light spirit $6{\cdot}8 \times 20{,}000$ B.Th.U.'s for 1s. 9d., and for heavy spirit $7{\cdot}6 \times 20{,}000$ B.Th.U.'s for 1s. 2d. are secured. The relative values are therefore:

$$\frac{6{\cdot}8 \times 20{,}000}{21} : \frac{7{\cdot}6 \times 20{,}000}{14}, \text{ or } 1 : 67.$$

That is to say, the heavy petrol would be more than one-half as valuable again as the light one; and one would consequently expect the price of 1000 candle-power-hours to reduce to 1·85d., as against 3·1d. This calculation, however, neglects to take any account of the waste heat (waste as far as producing light is concerned) necessarily used for carburation purposes and driving an engine, nor does it notice the value lost in waste from the carburettor and condensation in the mains. When these factors are taken into account, there is probably no vast gain from the use of the heavier spirit.

[The paper concluded with an examination of structural details of the plant.]

SUMMARY OF THE DISCUSSION.

Mr. W. J. A. Butterfield (invited by the President) said Mr. Hoddle's paper covered the ground so well that he thought there was little to be said upon it. A point that struck him while it was being read was that the systems of lighting by combustion in which the greatest economy per heat unit was secured were those in which a mantle was employed—preferably the inverted mantle. Acetylene was at a disadvantage in this respect; for although upright mantles had been used to a considerable extent with acetylene, inverted burners had practically not been employed at all, though some had been invented for the purpose. The reason why mantles were not in favour was, he thought, because the natural luminous flame of acetylene was so extremely good. There was no doubt that in pleasing effect it surpassed any other self-luminous flame. But merely judging by the intensity of the light produced, there was some little sacrifice of economy through mantle lighting being given up in connection with acetylene. Acetylene had several uses to which no other system of lighting was so well adapted. There were cases in which a large amount of light was wanted in conjunction with portability. The flare-lamps, for instance, surpassed anything else. He was much interested in hearing of the oxy-acetylene flame with ceria for producing light. It reminded him of the old attempt to produce a superior lime light by the use of zirconia with oxy-coal-gas. Had the ceria been tried with oxy-coal-gas? Personally he did not think the result would be nearly so good. Regarding acetylene heating-stoves, he believed the attempt to make these had been largely by the use of bunsen burners; and he noticed that Mr. Hoddle condemned the bunsen burner for lighting by acetylene. He (Mr. Butterfield) should like to know whether some pioneer of acetylene fires for heating rooms had tried to design one on the reflector principle—using a bright copper reflector and luminous flames, which was a type of fire which had vogue on the Continent with coal gas. It seemed to him (Mr. Butterfield), it would be much easier to make an acetylene fire of this type than to make one with bunsen burners, which, as he knew from experience with acetylene in laboratories where coal gas was not available, were rather troublesome. In respect to Mr. Scott-Snell's paper, generally speaking, he agreed with the author in his advocacy of a 5 or 6 per cent. mixture. But he (Mr. Butterfield) thought that in some respects a poorer mixture was better—for one thing, because one could be more sure of getting the exact proportions necessary for perfect combustion in the burner when the gas was prepared (so to speak) in the bulk in the equalizing or governing holder than if one depended on the injector action of the burner, because that was affected by slight variations of pressure, and dust and blockage of the burner. There was no doubt regarding the economy of air-gas lighting even at the present high price of petrol.

Mr. Thorne gave some figures that he had received as to the actual working cost of acetylene flare-lights in comparison with oil flare-lights. The flares were used for one week; and the saving effected by acetylene was £2 13s. 1d.; the candle power being approximately the same. With attendance, cleaning, and trimming (acetylene required very little attention), the cost of the

* A lumen is the unit of quantity of light, and is equivalent to an illumination of one foot-candle distributed over one square foot. In calculating the total flux of light over a floor, table, &c., one merely multiplies its area by the intensity of illumination. Thus in the above case 4 foot-candles over 100 square feet, or 400 lumens, were produced.

acetylene flares was £1 6s. 5d., against £3 19s. 6d. for oil-flares. As an acetylene engineer, the point that struck him about Mr. Scott-Snell's paper was that there seemed to be a particularly large number of pitfalls and stumbling-blocks in the use of petrol air gas.

Mr. PINNOCK said it appeared to him, from his general knowledge of the subject, that petrol air gas was not having quite the showing that it ought to have as regards the scientific aspects of the value of the light, and its effect on the sight. There seemed to be a general opinion that the softness and pleasing effect of petrol air gas stood unequalled. He believed that there were signs that the system would be of increasing importance. Many of the acetylene firms were now taking up petrol air-gas lighting; and this indicated their view that it had a future before it. Regarding Mr. Scott-Snell leaning rather to a 6 per cent. mixture, there were experts in the audience who could put a different complexion on this. If the ideal mixture was rather more than 2 per cent., then it seemed to him that the correct thing to do was to so gear the machine as to get this mixture automatically to the burners, and not leave it to just anybody to make the necessary adjustment at the burners all over a house. From the point of view of efficiency, it seemed to him there was much to be said in favour of the poor mixture.

Mr. W. J. LIBERTY remarked that he noticed that in the City of Westminster, flares were used during foggy weather. Could one of the authors tell him whether these were acetylene or oil flares?

Mr. DONNITHORNE held that the lighter petrol air-gas mixture was lower in cost than the richer mixture. It was also a more homogeneous mixture; and it followed that the better the mixture, the more complete the combustion. He imagined that, if a cold surface were brought near to the top of a bunsen burner using a rich mixture, carbon would be the result.

Mr. BREWER remarked that what Mr. Scott-Snell referred to was only relatively a rich mixture in comparison with what was popularly known as a 2 per cent. mixture. One must not run away with the idea that leakage from a pipe of Mr. Scott-Snell's mixture was going to be a dangerous thing. There was also the question of effect in installation. With a so-called rich mixture the piping could be smaller than in other systems using a poor gas. Mr. Scott-Snell advocated that the temperature in the carburettor should be the lowest in the system. He agreed with him, as then, if there was any condensation, it would occur in the carburettor. He inquired if Mr. Scott-Snell had tried benzol or any other product of the same nature. There was no reason why such a fuel should not be used. It was cheap; and its price would not be controlled, as was the case with the present fuel, by a powerful group.

Mr. BLATCHLEY remarked that one would hardly have supposed that five years ago it was almost the universal practice to use weak mixtures. Mr. Scott-Snell came to the conclusion, both theoretically and by practical experiment, that, rightly or wrongly, the correct mixture was a rich one. He started a campaign in favour of a rich 6 per cent. mixture. If to-day they took up the catalogues of other firms, they found that, while they still spoke of 2 per cent. mixtures, they said (with the exception of one or two firms who held that the 2 per cent. mixture was the correct one) that the mixture could be made rich or poor with their plants. This threw the responsibility in the matter upon the user. The whole thing was simply left to caprice. Mr. Scott-Snell had that night strongly expressed himself in favour of a 6 per cent. mixture. The Chairman had invited those in favour of a poorer mixture to take up the other side. What had been the response?

Mr. HODDLE, in reply, remarked that Mr. Butterfield had referred to the question of using mantles with acetylene, and agreed that he (Mr. Hoddle) was right in saying they were not required in connection with acetylene. The orifices of the lighting bunsen burners for acetylene were so small that the efficiency of the burner was easily upset. This did not apply to the burners used in acetylene stoves, where the consumption of gas was so much greater. Where a lighting burner only used ½ cubic foot, a gas-stove would use (say) 3 or 4 cubic feet. They had now useful acetylene-stoves. He might say that Messrs. Bray were quite of his way of thinking; they did not believe in incandescent acetylene burners, although they made them.

Mr. SCOTT-SNELL remarked that Mr. Butterfield held that the weaker petrol air-gas was much more efficient than the richer gas. This might be so; but it was certainly purchased at the expense of safety. That was his whole point. As to the Westminster flares, they were of the oil-type. The oil-flares were usually trotted out in fogs, because their yellow rays penetrated more. He adverted to the question of the richer mixture, and said that he preferred safety to homogeneity. Looking at the vapour tension of benzol, Mr. Scott-Snell did not think it would be found so suitable for their purposes as petrol.

RECENT DEVELOPMENTS IN GAS-MEASURING APPARATUS.

By Professor CARL C. THOMAS.

[Extracts from a Paper read before the American Gas Institute.]

DURING the past four years, a new type of apparatus has been developed for the measurement of gases, which in its different forms has met with marked success in various tests both in America and abroad. It is the purpose of this paper to describe this meter briefly, as to theory, construction, and operation, to show some of the results that have been obtained with it, and to discuss shortly its field of application so far as it may interest the artificial gas engineer.

The meter depends for its operation upon the principle of heating the gas electrically through a fixed range of temperature as it flows through a passage, and measuring the quantity of electrical energy required to produce this rise in temperature. Because of the employment of electrical energy as a source of heat, it may properly be termed an "electric" meter. It has been developed from fundamental principles; and a brief exposition of these and of the methods that are employed in carrying them out will serve to describe it.

FUNDAMENTAL PRINCIPLES.

The quantity of heat required to raise the temperature of a cubic foot of a given gas, under given conditions of temperature and pressure, through 1° Fahr.—that is, the specific heat of the gas—is a fixed quantity, and one which can be accurately computed. Moreover, this quantity remains the same, within practical limits, after this cubic foot of gas has been compressed to a smaller volume or expanded to a larger volume; also after it has been heated to a higher or cooled to a lower temperature. If gas, in flowing through a passage, is heated through a fixed and constant temperature range by means of a heater in the passage, it follows that the quantity of heat thus introduced is a measure of the quantity of gas flowing. This heat can be conveniently introduced by means of an electric heating unit disposed across the gas passage; and the quantity of heat supplied to the heater in the form of electric energy can be measured with various forms of wattmeters. By means of electric thermometors before and after the heater, the quantity of electric energy applied can be so regulated that the difference in temperature of the gas between the inlet and outlet of the meter is automatically kept constant.

DESCRIPTION OF THE APPARATUS.

Referring to the diagram, fig. 1, these principles have been applied as follows: In the gas-main is inserted an electric heating unit H, evenly disposed across the passage, and from which heat can be dissipated into the gas as it flows through it. This heating unit is connected across the poles of a switch in series with a regulating rheostat R and the current coil of a wattmeter. The rheostat regulates the energy supply to the heater in the manner described below, and the wattmeter continuously measures it. On each side of the heating unit is an electric thermometer T_1 and T_2. The function of these thermometers is, as the rate of gas flow varies, to regulate automatically the energy dissipated from the heating unit, so that the difference in temperature of the entrance and exit gas is always a fixed amount (about 1° C.). Under these conditions, if radiation and conduction of heat outwards from the heater unit through the housing are reduced to a negligible amount, the electrical energy supplied to the heater as measured by the wattmeter must be a measure of the quantity of heat dissipated into the gas. Since the rate of dissipation of this heat is directly proportional to the rate of flow of gas, the wattmeter can be calibrated to read directly in cubic feet of gas instead of in electrical units. The rise in temperature maintained by the heater energy is independent of the actual temperature of the gas. If gas enters the meter at 5° C., it leaves at 6° C.; if it enters at 30°, it leaves at 31°.

The thermometer units are of nickel wire, which increases its resistance with a rise in temperature, in accordance with a known and fixed law. When they are at the same temperature, their electrical resistances are equal. They form two arms of a Wheatstone bridge, the other two arms R_1 and R_2 being of a constant resistance material. Across the corners of this bridge is a galvanometer, the needle of which is balanced in its central position when the thermometers T_1 and T_2 are at the same temperature and therefore of equal resistance. When T_2 changes its temperature and its resistance relative to T_1, this needle is deflected to the right or left, and the deflections are utilized for the operation of the regulating rheostat R in series with the heater.

Power for operating the rheostat is supplied by a small motor, about ⅛ H.P., running continuously at constant speed. Through a series of gears operating in oil, this motor causes the pawls P_1 and P_2 to move continuously up and down through an arc along the edge of the ratchet-wheel W fixed on the shaft of the regulating rheostat. The pawls move past three teeth in their upward

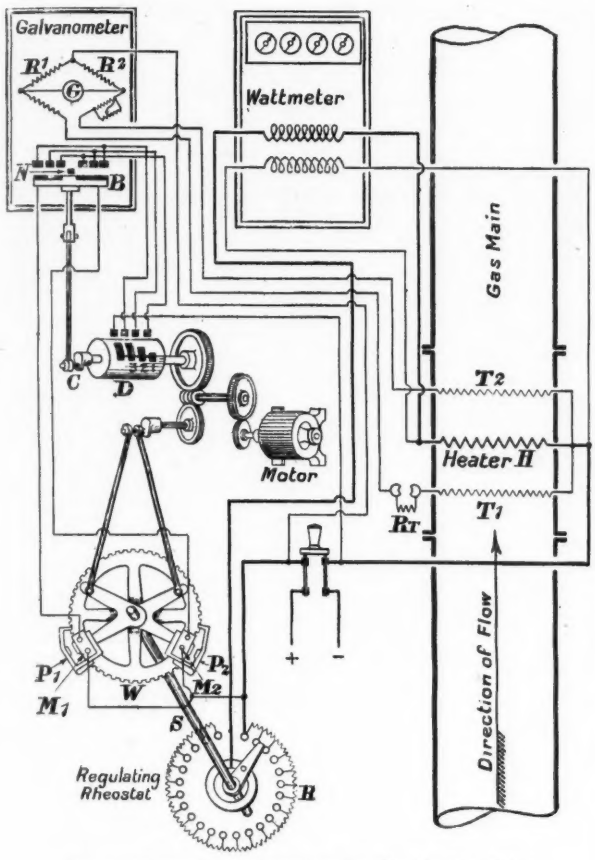


Fig. 1.—Diagrammatic Sketch of the Electric Gas-Meter.

stroke. If the magnet M_1 or M_2 is energized, the corresponding pawl P_1 or P_2 is pulled into engagement with the wheel, and moves that side of it upward during the remainder of its stroke. If the pawl is engaged at the bottom of the stroke, it moves the wheel three steps; if engaged a little later, two steps; and if pulled in as it approaches the last tooth in its upward stroke, only one step. The time at which the magnets are energized and the pawls thrown in is determined by segments of different lengths on the contact drum D, by which the circuit through the pawl magnets is made and broken.

The same set of gears which moves the pawls causes the galvanometer needle N to be clamped at intervals of a few seconds between the upper and the lower bars of a selective contacting device. If the needle is clamped in its balanced or central position, no current can pass through the pawl magnet circuit and the rheostat is not moved. If the needle is deflected one step to the right when it is clamped, the pawl circuit is closed by segment No. 1 on the contact drum D and the pawl P_2 is engaged in time to move the rheostat one step in a counter clockwise direction. This decreases the resistance in series with the heater by one step, and increases the electrical energy supplied to the heating unit. If the needle is clamped when deflected to the left one step, the pawl P_1 will be engaged, and the heater energy correspondingly decreased. If the needle is deflected two steps when it is clamped, the pawl magnet circuit is closed in time to move the rheostat two steps, &c. Thus deflections of the galvanometer needle to the right or left cause the heater energy to be increased or decreased by an amount somewhat in proportion to the deflection.

With the heater circuit broken, and therefore with no heat in the heating unit, and with gas flowing through the meter so that the thermometers are both at the same temperature, the Wheatstone bridge is balanced. Then, by removing a plug, a resistance R_T is inserted in series with thermometer T_1. This resistance has a value just equal to the increase of resistance of thermometer T_2 for the desired temperature rise, so that when T_2 is increased in temperature the desired amount over T_1 the bridge will again balance. On account of this addition of resistance R_T to one arm of the bridge, the galvanometer needle is now deflected full over to the right. The heater circuit is closed, the motor starts, and the rheostat is moved in accordance with the needle deflection until the energy supplied to the heater unit is just enough to maintain the desired rise in temperature in the gas as determined by the value of R_T. Then the galvanometer needle balances.

If after the meter once becomes balanced the gas flow increases, the energy in the heater is no longer sufficient to maintain the desired temperature rise, T_2 becomes less than 1° warmer than T_1, the galvanometer needle is deflected to the right, and the heater energy is thereby increased until it will maintain the desired temperature rise, and thus bring the needle back to a balanced position. Thus the heater energy continuously being measured by the wattmeter is automatically regulated so that the temperature rise in the gas is always constant as the rate of flow of gas varies from time to time.

The Meter in its Commercial Form.

The apparatus thus diagrammatically described resolves itself into two general parts—the housing in the gas-main containing the heater and thermometer units through which the gas flows, and a recording panel having mounted on it the control device and recording instruments. These two parts are connected by electric wires, usually in conduits, and may be several hundred feet apart. The housing in the pipe-line is usually of cast iron, and is made in various forms depending on the nature of service. It is, of course, designed to withstand any desired pressure. Within the outer housing, and so arranged that it can be quickly and conveniently removed, is a light steel inner casing. This serves as a gas passage through which all the gas must flow, and has mounted in it the measuring units evenly disposed across the section of the passage. Coarse screens in the ends of the barrel protect the units from mechanical injury. The outer housing is installed in the pipe-line as an ordinary fitting, and the inner barrel, with the measuring units, is afterwards inserted through a cover and the necessary connections made-up. Electrical connections lead out through the inner barrel and through pressure-tight terminal plugs in the outer housing. A gas-jacket is provided around the inner barrel; and in installations where it is possible for radiation to cause inaccuracies in results due to the loss of an appreciable amount of heat from the gas as it passes from one thermometer unit to the other, the outer housing is designed as shown in fig. 2. With this arrange-

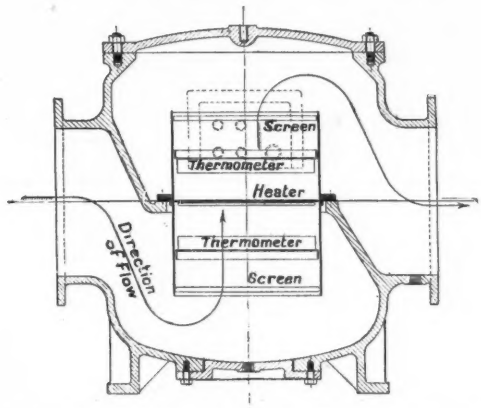


Fig. 2.—Electric Meter Housing, showing the Measuring Passage Jacketed with Live Gas.

ment the gas approaching and leaving the heating unit is jacketed by live entrance and exit gas respectively, which reduces radiation to a negligible amount, even when very wide differences exist in the temperature of the gas and surrounding atmosphere. This design is especially adapted to meters of small capacity. The heater unit consists merely of an electric resistance material evenly distributed over the area of the passage, so that all parts of the gas are evenly heated as it flows through and around it.

Comparative Tests.

Thorough tests have been made with the meter against several other types, with laboratory apparatus during the early stages of development, and later with some early installations to establish its accuracy under all conditions. During the past summer, an extensive series of tests was made in the Berlin Gas-Works against a station meter. Similar tests are being carried on by Messrs. Humphreys and Glasgow, at the Linacre works of the Liverpool United Gas Company. Three sets of these tests have been chosen for consideration in this paper as being representative of different fields of application. These tests are described briefly below.

Tests against a Station Meter in Berlin.

An electric meter designed for the measuring the discharge of air from blowers and compressors in a very extensive series of tests being carried out in Charlottenburg was temporarily installed in the Berlin Gas-Works, so that its accuracy might first be established by comparison with a station meter in the measurement of illuminating gas. It was connected directly in series with the station meter, and measured a mixture of coal and water gas as it came from the purifiers. The recording panel was located in a temporary wooden house just outside the main meter-house. The designed capacity of the electric meter was 20,000 cubic metres (706,342 cubic feet) per hour, while the rated capacity of the station meter was only 3600 cubic metres (127,500 cubic feet) per hour. Although tests were made with the integrating wattmeter, it was desired to make a fundamental investigation of the accuracy of this meter, and, with this purpose in view, precision indicating instruments were employed to measure electrical energy supplied to the meter. From an analysis of the gas and the value of the temperature rise used in the tests, a constant (0·651) was computed, representing the theoretical value of kilowatts per

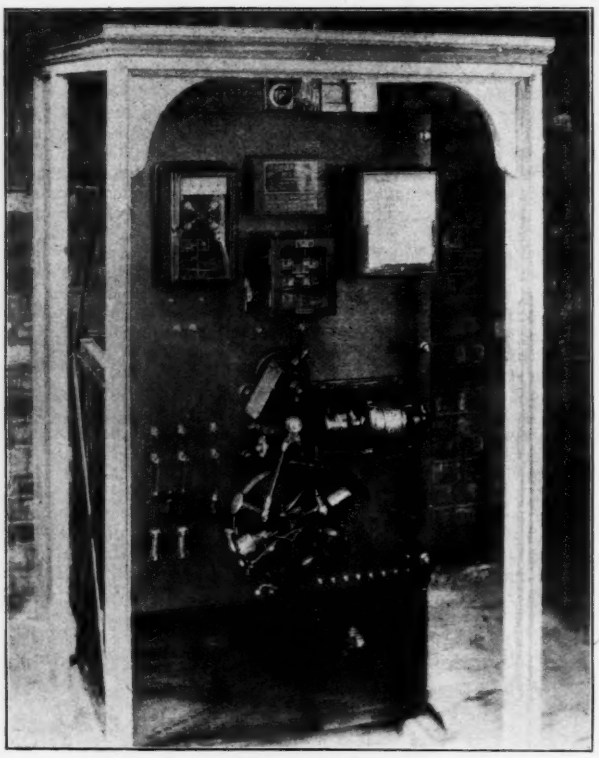


Fig. 3.—Recording Panel of the Thomas Electric Gas-Meter, at the Linacre Gas-Works, Liverpool.

1000 cubic metres of gas per hour. With this theoretical constant is to be compared the several values shown in the brief summary of the tests below for kilowatts supplied to the electric meter per 1000 cubic feet of gas per hour as measured by the station meter. This constant is about twice the normal energy used in practice.

Date.	Cubic Metres per Hour by Wet Meter (15·5° C. 760 mm.)	Kilowatts per 1000 Cubic Metres per Hour.
June 28	3804	0·647
,, 29	3350	0·654
July 1	4210	0·658
,, 1	2340	0·659
,, 4	3085	0·657
,, 5	4080	0·660
,, 5	2520	0·656
,, 6	1625	0·660
,, 15	1153	0·658
	Average	0·657

Each individual value here shown is the average result obtained from a series of observations taken in the most thorough manner with the view of obtaining an absolute comparison between the two meters under all conditions of gas production in the plant. It is worthy of note that the maximum and minimum capacities shown in the above tests are only 21 and 6 per cent. respectively of the designed capacity of the electric meter.

Tests against Holders of the Milwaukee Gas Company.

The table below is a summary of the results obtained with a meter fixed in the discharge-line from the booster station of the Milwaukee Gas Company. In these tests, the meter was checked against volumetric determinations obtained from each of the two holders adjoining the station.

	Test No. 1.	Test No. 2.
Holder used	West.	East.
Test begun	5.15 p.m.	11.0 p.m.
Test finished	7.30 p.m.	4.0 a.m.
Aver. rate of flow, cub. ft. per hr.	870,000	99,000
Cubic feet by holder	1,958,691	498,628
,, ,, electric meter	1,956,000	497,500

Although gasholder tests as ordinarily carried out may not be considered reliable for accurate volumetric determinations, the detailed report of these tests brings out the following points having important bearing upon their general value: (1) Two entirely independent tests were made against two holders differing very considerably in size. (2) A time was chosen when the atmospheric temperature and the temperature of the water in the seals corresponded very closely with that of the gas entering and leaving the holders. This precaution eliminated any appreciable errors due to unknown temperatures of the gas in different parts of the holders. (3) In test No. 1, gas was being pumped from the holders by positive blowers through the meter, which was only a few feet from them, at about 40 inches water pressure. In test No. 2, the gas flowed round the blowers through the meter at holder pressure only. (4) The average rate of flow in the second test is only about 11 per cent. of that in the first, and only about 3·3 per cent. of the maximum flow which this meter will measure.

Tests against Pitot Tubes with Natural Gas under Pressure.

The above tests were all made with artificial city gas at moderate pressures above the atmosphere. In view of the present tendencies towards high-pressure distribution of gas, this paper would be incomplete without reference to some tests showing that the high degree of accuracy as indicated in the two series already described still obtains at very high pressures. For this reason, and also to illustrate clearly that property of the electric meter by virtue of which it records rate of flow in units of standard pressure and temperature whatever may be the pressure and temperature of the gas being measured, a series of tests made with natural gas have been chosen. They were carried out at the Brave pumping-station of the People's Natural Gas Company of Pittsburg, where an electric meter was installed in series with a Pitot tube measuring station in a suction line to a large compressor station pumping natural gas into the city.

A 22-hour test was first made to establish the accuracy of the meter; and after this was completed a service test was carried out, extending over a period of a month and a half, to ascertain if the high degree of accuracy as established by the first test could be indefinitely maintained. The following is a brief summary of the tests:

	Cubic Feet.
Test for 22 hours by Pitot tube	8,784,800
,, ,, ,, ,, electric meter	8,764,000
,, by Pitot tube for 45 days	337,546,182
,, ,, electric meter for 45 days	336,732,018

At the end of a year after the completion of this series of tests, another test was made under exactly similar conditions without making any adjustment of the electric meter; and equally accurate results were obtained. In this later test, an orifice was also inserted in series with the other two types of meters.

The following are some of the important features of these tests: (1) While the tests were in progress, the gas pressure varied from 46 lbs. to 185 lbs. gauge, the gas temperature from 45° to 65° Fahr., and the rate of flow from 90,000 to 640,000 cubic feet per hour. (2) The electric meter gave continuous results which compared most favourably with those obtained by calibrated Pitot tubes and orifices only by careful observations and tedious reductions. Moreover, it gave these results directly in standard units, regardless of the severe pressure conditions already stated.

Conclusions to be Drawn from the Tests.

The tests herein described, and many more against other independent methods of measurement based on entirely different principles, have served to establish beyond doubt the accuracy of this type of meter under the varying conditions found in service. From a purely scientific standpoint, they are of interest, in that they form a check on the theoretical value of the specific heat of complex gases as computed from the specific heat of their components; and also upon the generally accepted statement that the specific heat of gases at constant pressure remains practically constant throughout the ordinary working ranges of pressure and temperature.

Engineering and Operating Features.

From an engineering and operating standpoint, the electric method of measurement lends itself to the design of a commercial form of meter possessing the following favourable features:

1.—It will give continuous integrated readings on a dial or graphic readings on a chart, or both, directly in standard cubic feet having any desired pressure and temperature—as, for example, 30 inches of the barometer and 60° Fahr.—whatever may be the actual pressure and temperature of the gas in the line. It accomplishes this by virtue of the fact that its basis of measurement is the specific heat of the standard unit of gas. This specific heat is the only known physical property of the standard unit which remains constant within commercial limits through the working variations of pressure, temperature, and composition.

2.—Its size and flexibility make it very convenient to instal. Meters of considerable capacity take up very little space indeed, and even the largest sizes require little or no foundations and no special housing, nor do they need special provision against extremes of atmospheric temperature. The recording panel may be installed in any convenient location, while the meter proper may be several hundred feet from it at a convenient point in the line. This flexibility permits of a central recording panel being used for several meters scattered through the plant. The energy supply may be either direct or alternating current at 110 or 220 volts; and the accuracy of the meter, as well as its operation, is independent of the voltage variations which ordinarily exist in private electric plants or in city supply lines.

3.—All parts on which accuracy of measurement depends can be periodically and effectively checked in service without even shutting off the gas from the line or dismantling any parts.

4.—At first thought, it would seem that the value of specific heat, and therefore the accuracy of the meter, would be very materially affected by the variations in the composition of the gas which occur in the ordinary operations of a city gas plant; also by the varying moisture content which exists in the form of vapour under different conditions. But this is not found to be the case. The variations in specific heat due to varying mixtures of coal and water gas, or of oil and water gas, which occur in the ordinary operation of a city plant are well within 1 per cent. In none of the comparative tests described were any corrections or allow-

ances made in the value of specific heat for the presence of water vapour carried by the gas. From a theoretical standpoint, an allowance of a fraction of 1 per cent. for water vapour should, and could easily, be made in the design of the meter; but in all the various tests made from time to time, it has been found that such a correction can be entirely neglected without introducing appreciable errors in the results.

5.—Deposits which occur on the inner parts of the meter in ordinary clean gas cannot affect its accuracy. The meter does not depend for its operation upon the physical dimensions of any of its parts or upon the velocity of flow through them; therefore changes in the passage areas due to deposits have no effect upon its operation or accuracy. Since the heater and thermometer units both dissipate heat to the surrounding medium, their temperatures are always higher than that of the medium; and this condition tends to prevent deposits on them.

6.—No straight length of approach is required. Since all the gas passes through each of the units, and since these units are so constructed that their resistance material can be evenly distributed over the cross section of the passage, irregularities in flow due to fittings before or after the meter do not impair the accuracy.

7.—The working range of the meter is in general about 25: 1. This can be increased in special cases. But these limits easily cover the range of flow through any single pipe supplying an independent town with artificial gas for light and fuel purposes; and greater ranges are seldom needed.

New Fields of Application.

To the artificial gas engineer, the electric meter offers, in addition to the field already covered, two new possibilities—the direct and accurate measurement of gases under pressure, and the measurement of gases from booster stations or between the storage capacity and the distribution lines. The increasing tendency towards the distribution of gases under pressure from central manufacturing stations to outlying districts and towns has created the demand for a meter which can be installed in small unheated houses or pits, and will give direct graphic and totalized records of flow under varying temperature and pressure conditions. The characteristics of the electric meter will make it adaptable to this service. To the city distribution engineer, a knowledge of the shape and value of the peak loads in his demand curves is gradually becoming more important through the increasing use of booster stations and the growing importance of storage and distribution problems. Heretofore, this knowledge has been obtainable only with great care and inconvenience, and always subject to the serious inaccuracies due to the attempt to read large holders at short intervals. In those cases where the pressures have not entirely prevented the satisfactory use of existing forms of meters, it has been physically and financially impracticable to measure the output of gas on account of the large number of meter units that would be required for the peaks and that would be idle a large proportion of the time. The large capacities and long ranges of accuracy that are possible in a single unit of the electric meter with its small physical dimensions, its ability to trace an accurate continuous graphic record of the rate of flow, together with its low first cost and small energy charge for intermittent service, should bring this new field of measurement within the practical reach of the progressive engineer.

[In an appendix to the paper are given in detail the tests and tables referred to in the text.]

"Transactions" of the Institution of Gas Engineers.

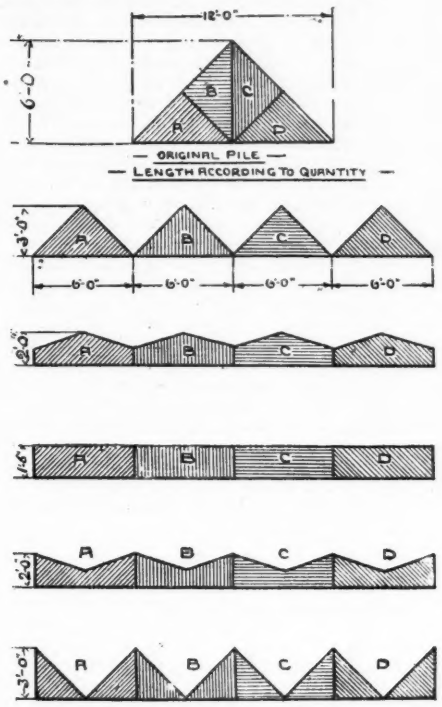
We have received the "Transactions" of the Institution of Gas Engineers for the past year. The volume, which appears about a month earlier than last year, contains a full report of the proceedings at the annual meeting held in London in June, under the presidency of Mr. Robert G. Shadbolt, the Engineer, Manager, and Secretary of the Grantham Gas Company. The papers, with the report of the discussions, have all appeared in the "Journal." The contents include accounts of the President's reception and the visit to Cambridge; abstracts of papers which appeared in various publications from July, 1911, to June, 1912; lists of the officers, council, committees, and members of the Institution, and the officers and committee of the Benevolent Fund; the names of the Advisory Committee on the Livesey Professorship of Coal Gas and Fuel Industries at Leeds University; and notices of the work of the members removed by death. The volume, which has for frontispiece a portrait of Mr. Shadbolt, has been produced under the editorship of Mr. Walter T. Dunn, the Secretary of the Institution.

Evolution of the Internal Combustion Engine.—We have received from Messrs. Charles Griffin and Co., Limited, of Exeter Street, Strand, a work bearing the above title by Mr. Edward Butler, the author of "Carburettors, Vaporisers, and Valves." It is explained in the preface that the purpose of the book is to present in a clear and concise form to engineers, designers, and others the basic principles underlying the construction and working of the class of engines mentioned. The text occupies 230 pages, and there are 188 illustrations. The price of the work (a fuller notice of which is in preparation, and will be given in an early issue) is 8s. 6d. net.

REVIVIFICATION OF FOULED OXIDE.

An American Method.

Among the "Wrinkles" contained in a recent number of the American "Gas Institute News" was one on the above-named subject, contributed by Mr. A. F. Kersting, the General Superintendent of the Mobile (Alabama) Gas Company.



As shown by the line A, the oxide, on removal from the box, is piled up in a long V-shaped roll. If the quantity to be handled and the space demand, more rolls can be added by laying them exact distances apart, and parallel to each other. The original piles are divided up into sub-rolls after the usual lapse of time for allowing the first "heat-up." As shown by the line B, the original large roll cuts up into four small rolls of one-fourth the size, each carefully V-shaped, with the bottoms of the rolls barely touching. After the necessary lapse of time for the surface to become thoroughly re-oxidized, these rolls are raked down by a hoe to the position indicated by the line C. In line D are shown the cones of the rolls thoroughly raked over into the valleys, and all of uniform depth throughout. Line E indicates the next raking-up, in which the oxide at the centre of the original roll is formed into cone shapes in the position of the original valley between the rolls. Line F shows the completion of the cycle.

Mr. Kersting points out that this allows an exposure to every particle of the oxide, and, with the dimensions given in the sketch, exposes it uniformly throughout, so that every portion of the oxide has been not more than 3 inches from the outside surface in contact with the air. He says he has found that this method works out perfectly, and that he gets complete revivification of his oxide with the least possible labour cost.

Recent Wills.—Mr. Charles David Phillips, a Director of the Newport (Mon.) Gas Company, whose death was announced in the "Journal" for the 29th of October last, left estate of the gross value of £78,188, with net personalty amounting to £69,319. The estate of the late Mr. George Silas Guy, the Chairman and Managing-Director of Messrs. James Russell and Sons, Limited, of the Crown Tube-Works, Wednesbury, has been valued at £150,914 gross and £112,047 net.

Paper Gas Pipes.—According to a paragraph in the "Ironmonger," based upon a statement by a French authority, paper can now be used for making serviceable gas-pipes, and two processes of manufacture are in use. In the first, the pulp is run into a mould, through which passes a mandril. It is then compressed, dried, and varnished. The tubes thus produced are rigid, and little liable to breakage; they keep well and are capable of rendering good service. In the second process, sheets of manilla paper are cut to a breadth equal to the desired length of the tube, and then passed into a bath of the cementing material—asphalt in a state of fusion. From this, when half cold, they are rolled tightly and uniformly round an iron bar, which forms the core. Successive sheets are added until the desired thickness has been attained. The tube thus formed is subjected to pressure in a special machine, and covered with fine sand, which adheres to the asphalt. The whole is plunged into water to finish the cooling, and exterior and interior are finally rendered impermeable.

PHOTOMETRY OF INCANDESCENT GAS-LAMPS.

By Charles O. Bond, of Philadelphia (Penn.).

[Extracts from a Paper submitted to the American Gas Institute.]

At the last annual meeting of the Institute, a paper was promised for presentation at this year's meeting to have the above title. By contrasting the devices and methods herein described with those which have heretofore appeared in the Institute proceedings on the subject of photometry, a measure is at once had of the change in the attitude towards photometry which we of the gas industry must adopt if we believe in progress, and hope to keep abreast of our competitors in the spirit of the times. The criterion of the future is to be this: Entrusted with a pound of coal drawn from the earth's reserve energy, and having, through education and experience, become expert converters of this energy, through gaseous form, to needful purposes, what is the maximum conversion factor obtainable and the minimum amount of energy necessary in order to accomplish safely and agreeably the desired service, of whatever character—we to be fairly compensated for our service? The object of this paper is to measure the production of incandescent gaseous illumination from the energy that is entrusted to us; and to learn the efficiency of production is to put ourselves in a position to apply the new criterion.

This is essential. We cannot know the degree nor direction to advance until we are well informed as to our present position. We need standardization. We need to have some well-defined, uniformly produced incandescent gas lighting units based on present efficiencies. The present paper describes such apparatus and methods as have come into use in the United Gas Improvement Company's photometrical laboratory in search of this information. It does not claim to have arrived at perfect incandescent gas photometry; this we assume to be the task of the International Photometric Commission.

It is illuminating engineering that has forced the demand for definite comparable information upon the available gas units, for on two points of maximum importance are contracts for lighting and schemes for installation based—the photometric curve of light distribution in a vertical plane under standard conditions, and the deterioration of the unit under normal usage.

As the field of the illuminating engineer embraces not only interior but exterior lighting, the variety of lamps which he must use is numerous, and means for testing all must be available. From the largest high-pressure street-lamp to the smallest miniature low-pressure unit, it is desirable for an efficiency factor to be adopted that renders all data furnished readily comparable.

Classification of Lamps.

All lamps can be divided into the two great groups of high and low pressure types. These may be further subdivided into upright and inverted, and indoor and outdoor. The true high-pressure lamps are primarily outdoor units of the arc lamp type, being heavily constructed and of high candle-power ranges. These use gas under from 2 lbs. to 3 lbs. pressure. In the high-pressure group may also be included all lamps of the self-contained or self-intensifying type, which, though supplied at a low main pressure, deliver the gas or mixture to the burner orifice at a considerably higher pressure than that of the supply main. In the same class are lamps operated with air under pressure or with suction on the exhaust. All lamps of the high-pressure class make use of some mechanism or physical aid other than plain injection from low main pressures.

In the low-pressure group, a much larger variety of types may be found. The further separation into groups is more or less arbitrary. Lamps have been classified as "arcs" when they are multiple units, upright or inverted, or a single unit giving over 150 mean spherical candle power; and as small lamps when giving between 40 and 75 mean spherical candle power inverted, or between 75 and 150 mean spherical candle power upright. All below these ratings have been termed "miniature" or "junior" lamps. [The author gave illustrations of lamps typical of each class.] Indirect and semi-indirect (or direct indirect) fixtures may be classified under specials or arcs.

The efficiency of lamps varies with the design and equipment used by the several makers; but while there may not be uniformity of design, size, and workmanship among the various makers, we can still hope to have a system of units graduated according to mean spherical candle power. We are still benefiting through this competitive manufacture and design by steady gains in efficiency, durability, appearance, convenience, certainty of operation, and variety of application.

A step in the right direction would be for the Institute to appoint a Committee for the purpose of conferring with manufacturers, illuminating engineers, and "new business" managers, with a view to deciding upon and recommending for adoption by the Institute such sized units as they shall deem to be best in the interests of the gas lighting industry. The lamps at present on the market could then be classified to correspond as closely as may be to the units recommended, and future lamps would be capable of such modification during their process of design as to closely conform thereto.

What Constitutes a Practical Lamp Test.

The simplest form of a test for an incandescent gas-lamp would be to determine the maximum candle power in any one established direction, together with the accompanying gas consumption and pressure; and it is this figure which is usually published. Such a test would be of value only where the other quantities to be measured were known to be in a simple proportion to the one given. Unfortunately this is not the case with most of the gas-lamps to be examined. The variations in glassware and reflecting inner surfaces of the lamp-casings require that the candle power should be read through 180°, in order to ensure a proper knowledge of the distribution of the light emitted.

In the photometrical laboratory of the United Gas Improvement Company, a system of testing has been evolved which includes almost every physical characteristic of the lamp under a wide range of varying conditions. The lamp is first of all photographed as received; there being placed in the vertical plane of its centre a scale marked in inches, and a display placard showing the date, test number, plate number, tester's initials, name and equipment of lamp, and total weight. The beginning of the test consists in determining the distribution of light in a vertical plane with the lamp new and equipped as placed on the market. This is to give fairness to the maker, who at the laboratory may place the lamp himself if he wishes and make all adjustments. This curve is determined while using a stored gas at a fixed pressure and under conditions as closely uniform as it is possible to obtain. This gas with us is a mixed coal and water gas of about ·67 sp. gr. and 640 B.Th.U. The procedure is as follows: The lamp is first of all examined for the simplest method of adjustment. There are three types of adjustments—(1) gas adjustment only, (2) air adjustment only, (3) both gas and air adjustment. This once determined, the lamp is set in place on the photometer with a swivel joint, and the mantle supplied with the lamp is placed and burnt off, lighting from the top. The glassware, thoroughly cleaned (and if of several kinds the most transparent, or if a clear cylinder the cylinder only), is then put in place. In order to ensure the equilibrium of heat in the lamp, and that all the volatile constituents used in collodionizing the mantle will be burnt off, and that the mantle itself shall assume its best shape with regard to the flame of the lamp, the gas is ignited, and the lamp is given a fitter's adjustment to approximate the maximum light, and the lamp is burnt for half-an-hour. After burning for this period, the lamp is readjusted (by using a photometer) to its best efficiency or the maximum candle power obtainable with attendant minimum gas and air supply; the latter adjustment depending upon the style of lamp on test. Once the proper adjustment is obtained, the lamp is allowed to burn for about five mintutes, after which the process of averaging commences. On upright mantles, the candle power is taken on six equi-distant azimuths at the 90 degree position, and on inverted mantles at the 75 degree position—the nadir position being at 0 degrees. The mean position is then set in the correct plane for photometering. Similar observations on any enveloping glassware are taken by revolving it relative to the lamp, determining, and then setting its mean position likewise. The data for the distribution curve are now determined from an average of several readings taken at each of 20 equi-zonal angles. If the distribution is at all irregular, further inter-angular readings are taken. Data on gas quality, consumption, pressure, and temperature, as well as on atmospheric pressure and humidity, together with characteristics of the standard lamp and all identifying conditions of test, are noted. An auxiliary test, showing the temperatures at various parts of the lamp, more especially those likely to be handled, is then made by means of a thermo-couple pyrometer in series with a millivoltmeter.

The lamp is then moved bodily into a 100-inch integrating sphere, and a check test made under identical conditions. The second stage of the test then follows. Coal gas is first used, and mean spherical candle power readings are obtained on the unit at 1·5, 2·5, 3·5, and 4·5 inches pressure; the lamp being given a fitter's adjustment with minimum attendant consumption at each pressure. The same procedure is followed on carburetted water gas and the previously mentioned standard mixed gas. Special note is also made of the noise at various pressures on the three gases; the measure being the type of noise—whether a hiss, popping, or roar—and the maximum distance horizontally at which it can be distinguished in a room ordinarily quiet. On the mixed gas a further procedure is followed. In order to determine the variation in efficiency and in candle power of the lamp through small changes in consumption, the gas is supplied at 2·5 inches pressure, and several eye adjustments of the lamp are made, so that the consumption varies on both sides of a maximum mean spherical candle power—consumptions and candle power data being noted. Curves are plotted showing both of these results, and fixing correct consumption. The mantle is then changed for a "standard" mantle of definite weight and saturation, and readings are taken at maximum efficiency. In order to fix a point of departure for the service test, the mantle originally supplied is replaced, and the lamp is given a final adjustment at 2·5 inches pressure, and its mean spherical candle power determined. The lamp is then removed and placed for service test on the life-rack, indoor or outdoor as the case may be. The lamp is operated for a maintenance period of ten days, being lighted on an average of five hours per day, and extinguished for the

remainder of the time. During this period, notes are made of the operation and behaviour of the lamp mantle or globe breakage, popping, flash-backs (more especially at ignition), carbonization, whistling or roaring, discoloration, and other information and incidents of interest. At the end of the period, the lamp is bodily removed and replaced in the integrating sphere, and readings are again taken. The total deterioration as a light unit is thus measured. The glassware is then removed and cleaned, replaced, and further readings taken with the supplied and standard mantles. From these data, made under conditions as closely approximating the original as possible, the losses due to the dirt accumulated on the glassware, in the lamp proper, and mantle deterioration can be computed.

In case the lamp as equipped for the market shows decided promise and efficiency, a further life-test is made. The lamp is then replaced on the life-test rack, and burnt for periods varying from 1000 to 2000 hours; and the same procedure is followed as before, or with different variations as desired. When the testing of the lamp is finished, it is taken apart, and a drawing is made to scale giving the dimensions, material, finish, and location of all constructional and operating parts, and showing at the points indicated the temperatures of the lamp when burning.

Variables Entering into the Photometric Test.

As the process of lamp-testing was developed, it was found that an unusual number of variables entered with more or less weight into the results obtained, especially on the distribution of light and the efficiencies. Every curve is made with some definite object in view; the principal ones being the efficiency of the lamp itself with the simplest glassware, or for the distribution of the light from some definite type of glassware. If the efficiency data are to be of any value, especially for intercomparison with data from other lamps, all the conditions under which they are obtained must be similar, or the variation due to each must be calculable and corrected for. If the distribution curve only is required, as for the calculation of an installation of similar lamps, the general conditions of operation under test must bear some definite relation to those of the installation had in mind.

The number of conditions that affect the direct ratio of light given out to energy put in are numerous; but those that, with a given type of lamp body, directly affect the curve, shape, and efficiency ratio may be reduced to about twelve: Kind of gas, specific gravity, calorific value, pressure, consumption, atmospheric humidity, thickness and uniformity of glassware, material, mesh, weight, saturation, and shape of mantle—all conditions relating directly to the construction of the burner from the gas inlet to the spent-product outlet, excepting the gas-orifice adjustment, being considered as fixed and beyond the operator's control.

Kind of Gas.—The usual limit of variation for any one lamp operated on artificial gas is coal gas, carburetted water gas, or a mixture of the two. A lamp designed for artificial gas could hardly be expected, without some modification, to operate satisfactorily on natural gas.

Specific Gravity.—The effect of sudden changes in specific gravity can be understood when it is known that the velocity of flow through the lamp orifice is inversely proportional to the square root of the specific gravity, and that the air entrained is proportional to the kinetic energy in the issuing gas. The following computation will show the specific gravity effect of changing at constant pressure from a 22·8-candle carburetted water gas to a 15·4-candle coal gas:

Carburetted Water Gas (Sp. Gr. ·667).

1 Cubic Foot of Gas.	Per Cent.		Air per Cubic Foot Required.	Cub. Ft. of Air.
Illuminants	9·8	×	14·36	1·409
CO	29·6	×	2·39	0·707
H_2	35·5	×	2·39	0·848
CH_4	15·2	×	9·57	1·450
C_2H_6	0·5	×	16·75	0·048
CO_2	4·0			4·498
O_2	0·6	×	5·0	0·030
				4·468
N_2	4·7			

Coal Gas (Sp. Gr. ·462).

1 Cubic Foot of Gas.	Per Cent.		Air per Cubic Foot Required.	Cub. Ft. of Air.
Illuminants	4·0	×	14·36	0·574
CO	10·0	×	2·39	0·239
H_2	49·6	×	2·39	1·185
CH_4	30·4	×	9·57	2·910
C_2H_6	0·6	×	16·75	0·101
CO_2	1·4			5·009
O_2	1·0	×	5·0	0·050
N_2	3·0			4·959

If then the volume of primary air entrained is proportional to the kinetic energy of the issuing gas, and knowing that the volume of gas issuing is proportional to its velocity, it can be proved that, with constant pressure, and using the same orifice, the volume ratio of gas to primary air entrained is independent of the specific gravity of the gas.

From the above computation, it is seen that the quantity (4·959 cubic feet) of air necessary for the complete combustion of 1 cubic foot of coal gas is different from the quantity of air necessary (4·468 cubic feet) for the complete combustion of 1 cubic foot of the water gas by the ratio of 1·11 : 1. Consequently, when in practice a change is made from water gas to coal gas, the primary air entrained shows proportionally less, and the tendency is for the lamp to carbonize. Where the change is from coal gas to water gas, the primary air entrained shows proportionally greater, and the tendency is to flash-back.

Calorific Value.—A pronounced effect noticed with a change of calorific value is the variation in the total flux of light; the candle power when the lamp is properly adjusted for each gas rising and falling with the calorific value of the fuel supplied within the range of artificial illuminating gases. A great deal of work has been done—particularly by members of the International Photometric Commission—on this relation of the incandescent candle power of gas to the calorific value; and the results seem to prove that, under conditions of proper combustion, the total light given out is almost directly in proportion to the amount of energy available.

Pressure.—The effect of pressure variation is very like that of specific gravity change. The quantity of gas issuing through a fixed orifice increases with the square root of the pressure, while the air entrained, due to the energy of the escaping gas, is proportional directly to the pressure. Consequently, the tendency is for a lamp to flash-back on increase and to carbonize on decrease of pressure. Some lamps are very sensitive to pressure variation, and are liable to carbonize readily; while others are equipped with governing devices that render them practically independent of such minor fluctuations as ordinarily occur in a low-pressure distribution system.

Consumption.—Improper consumption is generally due to improper adjustment, as on a uniform gas it will not vary. If a lamp is given too much gas without appreciably decreasing the candle power, slow carbonization may occur which will eventually totally carbonize both mantle and burner. If too little gas is supplied, the lamp may, when cold, flash-back on ignition, and in some cases may become almost impossible to ignite for this reason.

Atmospheric Humidity.—In the photometry of open flames by the pentane lamp, or by similar open flame standards, the atmospheric conditions affect both so nearly equally that correction for either is unnecessary. With incandescent gas lamps the case differs; and the effect of atmospheric humidity on the candle power and efficiency, though of an appreciable amount, has been almost entirely neglected. Especially is this noticeable where vacuum electric lamps, unaffected by atmospheric changes, are employed as the primary or secondary standard. It seems just, however, in a comparison between results obtained in winter, when the quantity of water vapour per cubic metre of dry air may be as low as 2 litres, and in summer, when it may be as high as 32 litres, that some correction should be made. Taking as a standard 8 litres, it has been found experimentally, through moisture control in a small metal chamber, that for each litre added to the air the following percentage losses in illuminating value occurred:

For an inverted lamp with inner cylinder			+ 0·785
,, upright	,,	straight chimney	+ 0·597
,, upright	,,	air-hole chimney	+ 0·407

Thus it can be seen that, if these experimental results be borne out in practice over a sufficient range of time and moisture for 30 litres, a correction for an inverted lamp of 23·55 per cent. would be required.

Thickness and Uniformity of Glassware.—Another difficulty that embarrasses the comparison of efficiencies lies in the variability of glassware. If all lamps were of a standard size for fitting glassware, much trouble could be eliminated. But they are not. The glassware supplied for a lamp may be any shape and almost any quality and thickness. An opal globe can hardly be compared with a clear one, unless the absorptive powers are known. In making a curve, the varying thickness of a globe may be somewhat corrected by using the averaging method above described, or by using the sphere test as a check to obtain a correction factor to use on the curve. The ideal method would be to have a standard sized globe ring and a clear colourless glass of minimum thickness for all efficiency tests.

Material, Mesh, Weight, Saturation, and Shape of Mantles.—No matter how excellent may be the design, workmanship, and operation of an incandescent gas-lamp, its chief reason for existence is the mantle it encloses; and so long as the mantle remains intact, the average consumer overlooks dirty glassware and low efficiency. This fact has left the door open for the entrance of lamps claiming wonderfully high efficiencies, and making good their claims initially. The methods of testing had to be enlarged to cover this class of lamps. Gradually there has been a method formed of distinguishing with speed and certainty between the results obtained with a "flash" mantle, which gives a very high candle power for a short time, and a "heavy" mantle that gives a lower candle power but for a considerably longer time. This quality depends upon the weight, saturation, mesh, and material. The lower the saturation, the higher the candle power will be. The material may be cotton, ramie, or artificial silk fibre, the apparent life and strength of the material increasing in the order shown.

These points are mainly covered in a test by determining the weight of mantle ash per unit area after burning one hour, and comparing it with an equal area of one arbitrarily chosen as a

normal standard. The weave and thickness of fibre have considerable influence on the weight; but in comparative tests the relative weights show fairly well what may be expected in performance. One of the vital requisites of a good mantle is that it should fit the flame. If the flame does not fill the mantle, there will be great loss in illuminating power; while if the mantle is too small, the flame is choked, and loss of capacity and efficiency will result.

Apparatus and Tabular Forms Used in Testing.

For the distribution curve work, use is made of radial photometers, using the substitution method with electric primary and secondary standards.

A 100-inch integrating sphere is used, having gas connections similar to those of the photometer. Lamps consuming up to about 30 cubic feet of gas per hour may be tested; but above this amount the ventilation is insufficient for continued use, and the lamp tends to smother. For such lamps, therefore, reading must be made quickly after proper adjustment and closing the sphere. Auxiliary appliances used are a Junkers calorimeter, Schilling's orifice specific gravity apparatus, and an electric motor rotary compressor set, with compression tank, regulator, and gauge.

To cover the calculations in the tests, a set of seven forms is required, so that all other work necessary may be done on a slide-rule.

Qualitative Gas Test.—On this sheet are recorded all the data descriptive of the gas used, which can be referred to at any time for corroboration. It includes a description of the sample, calorific value, specific gravity, candle power (as determined by the open flame), and chemical analysis. The last-named test is made only on special occasions.

Light Distribution in Vertical Plane.—The light issuing from the test lamp may be conceived as illuminating an enclosing sphere of unit radius. As gas-lamps are symmetrical about a vertical axis, their light distribution in one vertical plane through that axis will be a fair indication of the distribution in all other vertical planes. The surface of the sphere may be conceived as divided by horizontal planes into twenty equal area zones, ten of which are in the upper and ten in the lower hemisphere. The intersecting circles of these planes with the sphere's surface would appear, in a vertical sectional plane, as points on the circumference, and the enclosed arcs between these points would represent the zonal widths. In radial photometry, the zones may be indicated by their angular distance from nadir or 0 degrees, and the light intensity in a given zone would be indicated by the candle power as measured at the angle representing the position of its weighted mean area. These angles are indicated in the first column of the sheet. If the substitution method is used, the candle power values, as calculated from the slide rule, are entered in the column for the corrected candle power, and another calculation is made for mirror absorption to obtain the apparent true candle power. By choosing these ten equal zones in each hemisphere, one-tenth of the sum of the ten apparent true candle power values is equal to the mean hemispherical candle power, and the mean of the upper and lower hemispherical candle powers equals the mean sperical candle power. All results are subsequently checked by another person than the one making the test.

Integrating Sphere Test.—The spaces at the top of this sheet correspond to those on the sheet just alluded to. Mean spherical candle power values are an average of several readings made to obtain the maximum efficiency at each pressure. Columns marked "After Life-Test" include the readings taken with clean and dirty glassware, and with "supplied" and "standard" mantles. The "standard" mantle readings made before the life-test are also entered with the mixed gas tabulated data.

Lamp Life-Test Record.—The headings on this sheet correspond with those on the two last-mentioned sheets. Under the heading "Remarks," are entered all points of interest, such as flash-backs, carbonization, mantle or globe breakage, or necessary change of adjustment.

Small and Large Curve Sheets.—These two sheets are of the well-known form of polar diagram, and on them are plotted the corrected vertical distribution curves. On the former sheet complete data of conditions under which the curve is made are given, together with a small sketch of the appearance of the lamp in the plane of distribution; the latter is used where an enlargement is required for the comparison of special curves obtained under similar conditions.

Efficiency Factor and Some Results Obtained.

In the results obtained after long research by M. Sainte-Claire Deville, and reported at the International Photometric Commission at Zurich, it was fairly well established that the light given by an incandescent gas-burner is almost directly proportional to the net heat supplied by the gas when burnt under proper conditions—that is, when the burner is best adapted to the gas used, and a perfect mixture of gas and air can be obtained with the flame completely filling the mantle. Therefore, a burner will not give the same thermal efficiency when used on a rich and a lean gas. Conversely, it should be possible to obtain the relative adaptabilities of two or more burners by a comparison of their efficiencies on a standard or nearly uniform gas. This would certainly be a measure of the usefulness of any burner or burners in a town or city where a fairly constant grade of gas is furnished all the year round.

Also, as the total light given by any lamp is the quantity it is desirable to know to make calculations and comparisons, irrespective of the form of the distribution curve obtained under any fixed set of conditions, it would be fitting that the comparative efficiency factor as supplied by the result of a test should be measured in total lumens per British thermal unit per hour—both being measures of quantity of energy, one given out and the other put in. By this measure also we are able to ascertain, through the use of the three gases mentioned, with which of the gases the burner as equipped would be most efficient.

The actual numerical value of the quantity "lumens per B.Th.U. per hour" for the various types of incandescent gas-lamps on the market lies between 0·2 and 0·7. This is a number readily remembered, and one that is simple in its order of digits.

It is not reasonable to suppose that the heat of condensation of water vapour will ever be capable of use in the heating of a mantle; so that this factor of "lumens per B.Th.U. per hour," it might be thought, should be based on the net calorific value. The factor is intended, however, to show the true relation between energy input and illumination output; and so the total B.Th.U. should be used. This is one factor in accounting for the lower figures usually obtained for coal gas high in hydrogen.

In the following table are given a number of commercial efficiencies as obtained by the process outlined during the past two years. The results obtained on coal (C), water (W), and mixed (M) gases are given for each lamp, using the gross heating value, for the reason given above, and as recommended by the Institute. The ten lamps referred to in the table are described as follows: (1) One-burner inverted high-pressure lamp. (2) One-burner inverted high-pressure lamp; air supplied under 2·1 inches pressure. (3) Four-burner low-pressure inverted outdoor arc. (4) Four-burner low-pressure upright outdoor arc. (5) Three-burner low-pressure inverted indoor arc. (6) One-burner low-pressure upright indoor arc. (7) One-burner low-pressure inverted indoor unit. (8) One-burner low-pressure upright indoor unit. (9) One-burner low-pressure inverted miniature unit. (10) One-burner low-pressure upright miniature unit. All glassware clear or corrected for absorption.

	Gas. Kind.	Sp.Gr.	B.Th.U.	Litres. H_2O.	Pressure.	Consumption. Cub. Ft.	Mean S.C.P.	Lumens. B.Th.U. per Hour.
1.	C	·540	568	26	2·0 lbs.	14 46	383·0	·537
	W	·708	614	32	2·0	11·37	338·0	·627
	M	·690	614	26	2·0	12·63	396·0	·640
2.	C	..	..	..	..	..	..	..
	W	..	..	..	..	..	..	..
	M	·640	638	..	2·0 in.	8·24	242·0	·578
3.	C	·495	612	17	2·5	15·14	212·0	·288
	W	·700	654	16	2·5	14·50	191·0	·251
	M	·669	658	16	2·5	14·56	212·0	·283
4.	C	·471	554	10	2·5	24·86	141·0	·131
	W	·720	630	10	2·5	18·85	219·0	·230
	M	·672	603	13	2·5	19·34	232·0	·233
5.	C	·495	585	10	2·5	11·55	141·0	·265
	W	·703	673	12	2·5	9·98	184·0	·345
	M	·655	649	12	2·5	10·08	188·0	·362
6.	C	·432	590	8	2·5	10·54	120·0	·239
	W	·708	654	11	2·5	10·34	144·0	·269
	M	·659	630	13	2·5	9·61	148·0	·306
7.	C	..	607	7	2·5	4·32	71·9	·345
	W	..	653	7	2·5	4·05	76·6	·364
	M	..	657	9	2·5	4·06	79·6	·375
8.	C	·454	621	20	2·5	3·55	50·5	·288
	W	·722	623	25	2·5	3·00	56·8	·382
	M	·652	618	25	2·5	2·89	55·2	·388
9.	C	·400	609	21	2·5	1·47	28·0	·394
	W	·695	691	21	2·5	1·60	37·8	·430
	M	·677	661	21	2·5	1·73	35·0	·384
10.	C	·452	592	26	2·5	1·57	23·5	·319
	W	·717	632	26	2·5	1·21	27·0	·443
	M	·674	641	27	2·5	1·26	28·4	·440

Notes of Interest and Conclusion.

Critics of the photometric method here outlined will have noted the fact that no correction means have been used to eliminate the difference in colour of the two fields in the sight-box. Other points may also be mentioned that would ensure greater accuracy of work. It must be remembered, however, that the chief object of this paper was to describe a practical method found convenient for the comparison of commercial lamps, and not an ultra-scientific determination of the qualities necessary in a gas-burner for obtaining the maximum efficiency on any particular kind of gaseous fuel. We feel that the laboratory has met the first requirements laid upon it, and that now there is to come a gradual increase in research work and in the refinement in method and apparatus necessary to the successful prosecution of it.

Gas-Engines v. Steam-Turbines for Small Powers.—Mr. S. Z. de Ferranti, in the course of the Watt anniversary lecture at Greenock, discussed the future of the internal combustion engine and the steam-turbine, and agreed that for small powers the former was in every way the best. He, however, deprecated the use of such engines for larger powers in favour of the turbine, which became more and more economical, and was easier to construct. It is interesting to have this good word in favour of the gas-engine from one so eminent in the electrical world, as it is more especially with the smaller power engines that the gas manager has to deal, and to which he has to look for the extension of the use of his gas for power purposes.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Waste Heat of the Gas-Oven.

SIR,—I was much interested in the editorial article on this subject that appeared in your columns simultaneously with the account of my tests, under practical working conditions, of the use of waste-heat intercepting water-pads with my "Seal" cooker, for the purpose of raising the temperature of water [*ante*, pp. 13, 37]. There was one point in your article I considered should be at once answered, and that was whether the "primary purpose of the gas-oven" was affected by any temperature variations occasioned by the drawing off of hot water, and replenishing the pads with cold water, during the use of the oven. I have made inquiry at home; and nothing of the kind has been observed. This is practical experience. But I desired to confirm this by temperature tests before writing to you on the subject. Tests have now been made; hot water being drawn and cold inserted with the gas-oven heated up, and temperature readings being taken frequently throughout the run on two days. The tests were made on Jan. 13 and 14.

TEST—JAN. 13.

Test of "Seal" oven, fitted with water-pads (8 quarts at each side, and 6 quarts at back) to ascertain the effect on oven temperature by drawing water at intervals; cold water displacing the hot. [The pads have a total capacity of 5½ gallons, and the cold-water cistern one of 4 gallons—9½ gallons in all.] The apparatus was filled with water at 43°. Outside temperature, 30°. Oven fitted with cast-iron flues; and galvanized iron water-pads. Thermometers inside oven 3 inches down from the top, and 3 inches up from the bottom. Gas consumption: 10 cubic feet in twenty minutes; then shut down to 15 cubic feet per hour. No cooking proceeding.

Gas Lighted, 10.10 a.m.

		Oven Temperatures.		Water Drawn From	
Time.	Gas Used.	Top.	Bottom.	Right Side.	Left Side.
10.30	10 ft.	270°	275°		
Gas reduced.					
11.0	17½ ,,	380°	385°		
11.30	25 ,,	420°	415°	At Tap. In Pail.	
12.0	32½ ,,	442°	435°	2 gal. 135°	129°
12.15	—	445°	435°		
12.30	—	450°	440°		
1.0	—	460°	450°		At Tap. In Pail.
1.20	—	—	—		2 gal. 182° 171°
1.30	—	470°	460°		
2.0	—	470°	460°	(Commenced to replenish with cold water.)	
2.10	—	465°	455°	2 gal. 190° 181°	174° 163°
2.30	—	462°	454°		
3.0	—	465°	460°	174° 160°	158° 143°
3.30	—	465°	465°		
4.0	91½ ,,	465°	460°	166° 156°	— —
Gas extinguished.					
5.0	—	240°	205°	146° 124°	153° 136°
					1 gal. 122° 118°

Pads still warm at top after drawing water.

NOTE: The apparatus was first filled with 9½ gallons of water from main; temperature, 43°. The second 9½ gallons was supplied from a cistern tap; temperature, 49°.

TEST—JAN. 14.

Test of No. 1 "Seal" oven, all as described on test of previous day, but with the thermometer index outside the oven-door; the stem with the bulb only being inside the oven. 19 gallons of water heated and drawn at intervals as before. Initial water temperature, 43°. Outside temperature, 36°. The same thermometers were used in each test.

It should be noted that in this test the oven-door was not opened; and there was no fall in temperature. These readings with thermometers fixed outside do not give the actual temperature inside the oven, which is shown by the test on Jan. 13 to be about 100° hotter. The thermometers used have strong brass cases, with angle stem 6 inches long to pass into the oven.

To heat 19 gallons of water on the top of the gas-cooker would require 76 cubic feet of gas.

Gas Lighted, 11.0 a.m.

		Oven Temperatures.		Water Drawn From	
Time.	Gas Used.	Top.	Bottom.	Right Side.	Left Side.
11.20	10 ft.	225°	250°		
Gas reduced.					
11.50	17½ ,,	295°	290°		
12.20	25 ,,	330°	315°	At Tap. In Pail.	
12.50	32½ ,,	345°	328°	2 gal. 139°	131°
1.5	—	347°	332°		
1.20	—	350°	336°		
1.50	—	360°	340°		At Tap. In Pail.
2.10	—	361°	344°		2 gal. 191° 173°
2.20	—	362°	345°	(Commenced to replenish with cold water.)	
2.50	—	362°	345°	199° 188°	176° 162°
3.0	—	362°	345°		
3.20	—	362°	345°		
3.50	—	362°	346°	178° 164°	156° 144°
4.20	—	366°	355°		
4.50	92½ ,,	371°	360°	170° 160°	
Gas extinguished.					
5.50	—	183°	150°	152° 141°	153° 136°
					1 gal. 110° 84°

NOTE: The apparatus was first filled with 9½ gallons of water from main; temperature, 43°. The second 9½ gallons was supplied from a cistern tap; temperature, 47°.

It is my opinion, on the results of these tests, that with pads outside the "Seal" oven drawing water as shown will not have any appreciable effect on the cooking operations.

I shall be pleased to make arrangements for anyone interested to come and verify these tests for himself.

THOMAS POTTERTON.

Balham, Jan. 15, 1913.

National Health Insurance Act, 1912, Part II.

Mr. R. W. Edwards, of Aldershot, referring to his letter published in last week's "JOURNAL"—in which he said that he had called the attention of the Secretary of the Institution of Gas Engineers to the decision of the Umpire No. 1229, in which contributions were stated to be payable by workmen engaged in the substitution of vertical for horizontal gas-retorts, and in the conversion of gasholder tanks to tar-tanks—informs us that he has since received a letter from the Institution.

In this letter, the Secretary stated that he had communicated with Mr. Alexander Wilson, of Glasgow, a prominent member of the Committee on the matter, and he had replied that, so far as decision No. 1229 was concerned, it seemed to be in order. With regard to Mr. Edwards's suggestion that a detailed list of decisions affecting the gas industry should be prepared by the Committee and available for members on application, the Secretary pointed out that Mr. Wilson had prepared a full list of decisions for the use of Glasgow, which was printed in the "JOURNAL" for July 16 last (p. 175); and he enclosed the following copy of the later decisions, which Mr. Wilson had sent him.

[ENCLOSURE.]

Additional Decisions by the Umpire.

Contributions Payable.

407.—Workmen employed by a gas company, and described as gas-fitters, who are engaged wholly or mainly in the work of piping customers' houses and repairing for escapes of gas.

548*.—A workman described as a gas-fitter, fixing and running gas-pipes and fittings *to* buildings.

600*.—Gas-fitter fitting up pipes *into* customers' premises.

1009.—Workmen employed in the manufacture of station gas-meters, and described as tool fitters, tool makers, tool turners, tool machinists, and their assistants or labourers.

1025.—Workmen engaged wholly or mainly as gas-fitters, doing gas-fitting on stations and signal-boxes, &c.

1072.—Workmen engaged in running gas-pipes from a gas company's service in the basement of a block of tenements to the various rooms in the tenements.

1133.—Workmen engaged in making and assembling gas-governors.

1229.—Workmen employed in the substitution of vertical for horizontal gas-retorts and the conversion of gasholder tanks into tar-tanks.

Contributions Not Payable.

604.—Workmen employed by the gas department of a city council, and engaged in fixing and removing (removable) gas-stoves.

711.—Workmen described as gas stokers, employed during most of the year as stokers at gas-works, and part of the year as labourers in the works and yard, assisting in the overhauling, cleaning, and repairing of plant and apparatus, provided they are not employed wholly or mainly on repairs to buildings or machinery.

779.—Workmen engaged in running gas-services from the main to the consumers' meter.

Fixing gas-meters in houses.

802.—Workmen engaged wholly or mainly in general repairs to removable gas-cookers, gas-fires, or gas-fittings other than pipes in customers' houses.

865.—Workmen engaged in the manufacture of gas-testing apparatus, or in testing and fitting incandescent gas-burners, except in so far as same is covered by decisions relating to ironfounding.

* Decisions 548 and 600 are covered by the amended decisions 1072 and 779.

Electric Light Failure at Westbourne Park Station.—Just before ten o'clock last Wednesday night, much confusion occurred at the Westbourne Park Station of the Metropolitan and Great Western Railway by the failure of the electric light. For about twenty minutes not a light was to be seen on any of the many platforms of this busy station, and the incoming trains moved very slowly and cautiously to the platforms. Even the booking office and hall were in darkness, and the issue of tickets had to proceed by matchlight. A fused wire is said to have been the cause of the trouble.

Need of a Water Supply for Barkisland.—At a Local Government Board inquiry at Barkisland, near Halifax, last Wednesday in regard to the application by the District Council for power to borrow £3200 to provide a public water supply, evidence was given by Dr. J. Hoyle, the Medical Officer of Health, that many places in the district were without water three or four months of the year. A farmer who attended volunteered the information that where he resided there had been no supply for thirty years. He had to carry all his water a quarter-of-a-mile. Mr. W. Holmes (County Council Inspector) said the County Council had been urging for the scheme to be deal with since 1897. He hoped the matter would be pushed forward quickly.

Proposed Transfer of the Rochford Water Undertaking to the Southend Water Company.—A parish meeting was held at Rochford on Monday last week to consider the Bill which has been promoted by the Rural District Council to obtain sanction for the transfer of the water undertaking to the Southend Water Company. It was explained by the Clerk to the Council (Mr. F. Gregson) that the Company were to take over the undertaking as a working concern from September, 1913, at the amount of the loan indebtedness on March 31, 1912, which was £20,372. The Council had, roughly speaking, paid off one-third of the original loan; and as soon as the Bill passed, the undertaking would be conveyed to the Company. As from that time, the six parishes concerned would be included in the area of the Company; and the charges would be about 27 per cent. lower than those of the Council. Opposition was offered to the sale of the works on the terms proposed; and a resolution was passed that the Parish Council should be urged to oppose the Bill in Parliament.

REGISTER OF PATENTS.

Mechanically Operated Poker for Retort Furnaces.

GILL, G. M., of the Commercial Gas-Works, Wapping, E.

No. 29,127; Dec. 27, 1911.

This invention relates to a machine for mechanically poking the furnaces by which gas-retorts are heated; the poker rack bar sliding in a plate and angle channel fixed at the required angle, and fitted with rollers at the front or lower end—one fixed above and one below the poker bar.

The arrangement was fully described by the patentee in the course of a paper he read last November before the Southern District Association—see "JOURNAL" for Nov. 19, p. 591; also "JOURNAL" for May 7, p. 353.

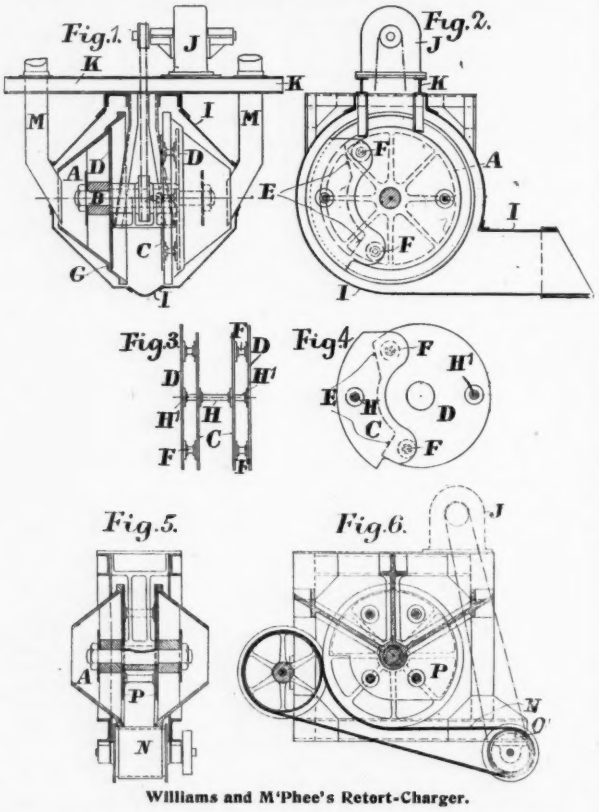
Charging Retorts.

WILLIAMS, P. E., of Wanstead, Essex, and M'PHEE, N., of Poplar, E.

No. 415; Jan. 5, 1912.

This invention relates to apparatus which "enables retorts to be charged with material projected by reason of the momentum acquired while in contact with a surface or surfaces travelling at a high velocity"—the object being "to provide simple means in which the material is supplied to a rotary projector at one side thereof, then traversed laterally by the projector, and finally discharged at the opposite side."

The projector is made in the form of a truncated cone having an inlet at the smaller end and rotating with respect to a stationary base of an irregular part of annular shape; the interior of the cone being preferably provided with a number of radial arms or blades serving to divide the projector into compartments. The projectors may be used alone or in conjunction with an endless band travelling at a speed not less than the peripheral speed of the projector for use in the usual way in assisting the charging of a retort. In order to maintain the material in sufficiently prolonged contact with the projector before being discharged, means (such as a partition or baffle intermediate of the inlet and the stationary base) may be provided; such partition having an opening arranged behind a masking part of the base, and the arrangement being such that the material, after passing the partition or baffle, is engaged by a larger portion of the projector, which imparts to the material its final discharge velocity.



Williams and M'Phee's Retort-Charger.

Fig. 1 is a part sectional front elevation, fig. 2 a part sectional side elevation, and figs. 3 and 4 front and side elevations of details of figs. 1 and 2.

The apparatus in the example shown comprises a pair of conical projectors A, mounted upon a common shaft B so as to rotate at opposite sides of a pair of stationary base-plates C (fig. 3), spaced apart to an extent corresponding more or less to the width of the retort to be charged. Each base-plate is shaped as fig. 4, and disposed in front of an opening in the partition D, which may assume the form of a quadrant E. Each partition is carried by distance-pieces F from the adjacent base-plate C, and arranged to engage a shoulder in the conical projector formed by stepping the latter. H is a distance-piece connecting together the base-plates C; and H^1 is a similar distance-piece connecting together the partitions D. Associated with the projectors is a shield I, to as far as possible prevent dust raising—the shield being preferably adjustable in relation to the projectors and adapted to extend as closely as possible to the retort-mouth. The projectors A, the motor J for driving these parts, the base-plates C, and associated parts, are carried by the auxiliary frame K, which is mounted on another (the main) frame. The latter frame is adapted to be traversed along the bench of retorts, and the supplementary frame is adapted to be moved towards and from each retort opposite which the charging apparatus is brought, and to be elevated to different heights.

The coal-hoppers for supplying the projectors may be carried by the main framing and have vertical shoots communicating with the inlet ends of the cones, and, if not movable vertically (although travelling along the bench with the projectors), may have the shoots made telescopic. M represent the shoot portions carried by the auxiliary frame K.

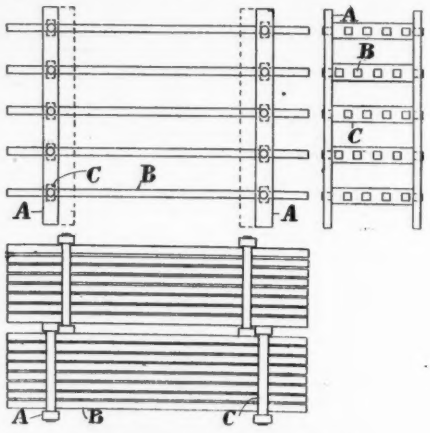
In figs. 5 and 6, which are similar views illustrating a modification, the projectors A are arranged to discharge on to a travelling band N, one of the drums O for which is adapted to be driven by the motor J. In this case, the band N may be used to drive the projectors A, which are shown as co-acting only with base-plates P—the partitions being omitted.

Gas-Purifier Grids.

CROSSLEY, H., and HOBBS, F., of Elland.

No. 3142; Feb. 7, 1912.

As shown, the grids are built in units to form independent self-supporting structures which comprise uprights A with cross-bars B, for supporting the oxide, rigidly secured by means of horizontal bearers C through which the cross-bars pass, or to which they are secured. The cross-bars thread diagonally through the horizontal bearers. The uprights of alternate units are arranged to interlock, so that th e different units can be placed close together and the distance between the cross-bars for supporting the oxide kept approximately constant throughout.



Crossley and Hobbs' Purifier Grids.

In order to enable the uprights to interlock, those of one unit are formed somewhat closer together, so as to fit against and between the adjacent and corresponding uprights on the next unit or grid, as shown in plan. The cross-bars on one set of bearers break-joint, or are arranged in staggered relation relative to the cross-bars on the bearers immediately below and above. The cross-bars also preferably project somewhat beyond their respective bearers at each end of the unit, so as to meet the corresponding cross-bars of contiguous grids in a longitudinal direction of the cross-bars.

Purification of Lighting Gases.

GUILLET, O., of Clermont Ferraud, France.

No. 18,597; Aug. 13, 1912. Convention date, April 2, 1912.

This invention relates to a process which "enables the whole of the carbon disulphide, industrially speaking, to be removed, so that the gas, after purification, contains practically no sulphur, and can be burnt without inconvenience even in badly ventilated premises."

The gas coming out from the ordinary purifiers passes through a further purifier, also filled with oxide of iron, but heated by some outside source of heat to a temperature varying from 80° to about 200° C. As the gases still contain a quantity of water, the carbon disulphide, on contact with the water, gives the well-known reaction:

$$CS_2 + 2H_2O = CO_2 + 2H_2S.$$

Oxide of iron absorbs sulphuretted hydrogen as it is being produced, so that the reaction takes place until carbon disulphide disappears. The oxide of iron becomes gradually sulphuretted, and must be renewed when its action is exhausted.

It has been proposed, the patentee points out, to remove the carbon bisulphide from gas which has been partially purified from sulphuretted hydrogen, by converting the carbon bisulphide into sulphuretted hydrogen by means of heating the gas with the addition of steam to high temperatures (400 to 1000° C.), sufficient to produce this reaction; the sulphuretted hydrogen resulting being then removed by ordinary methods. It has also been proposed to purify coal gas from carbon bisulphide by passing it over metallic iron sponge heated to any suitable temperature; the iron being converted into iron and sulphur compounds. The metallic iron sponge could be obtained by passing impure or ordinarily purified coal gas through a heated vessel or retort containing rich iron

ore or oxide of iron in pieces, in order to reduce the iron ore or oxide to metallic spongy iron.

Both these prior processes are, he says, more costly and complicated than that of the present invention, and require the expenditure of a greater amount of heat. The process according to the present invention can be combined with the usual purification, by causing the crude gas mixed with the proportion of air usually required for the regeneration of the oxide of iron (or without the air) to pass directly into the hot purifier. The whole of the sulphur, in the shape of sulphuretted hydrogen and carbon disulphide, is then fixed in one operation. In that case, and if air has been used, the gas can have an acid reaction. Consequently, it is advisable to provide, at the outlet of the purifier, for the washing of the purified gas in any desired alkaline solution.

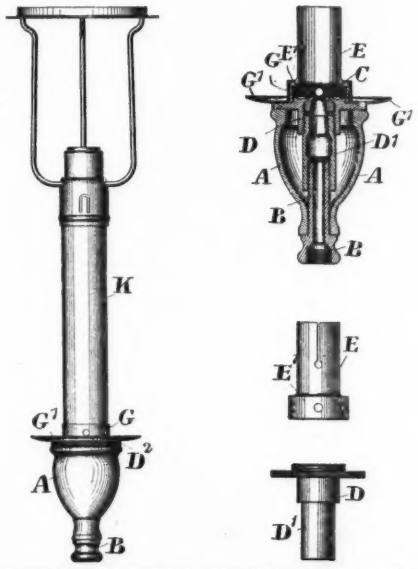
A considerable fraction of the heat required can be saved by causing the gas coming from the hot purifier to pass through a heat-exchange device, which will enable the gas entering the purifier to be heated—the consumption of fuel thus being reduced. It is, finally, easy to instal side by side two hot purifiers, so that when one is working the other should be emptied or refilled with oxide of iron and gradually heated so as to be ready to start working at the moment when the first one is completely sulphuretted. The arrangement could also be made so that fresh oxide introduced into the purifier from the top should come out at the bottom already sulphuretted, in a continuous manner, by travelling in the direction opposite to that of the gas.

Incandescent Gas-Burners.

EVERED, S., and BOXALL, J. E., of Smethwick.

No. 9239; April 19, 1912. No. 17,956; Aug. 2, 1912.

This combined invention describes the construction and arrangement of the parts of incandescent gas-burners made to have the appearance of wax candles.



Evered and Boxall's (Imitation Candle) Incandescent Burners.

A is the imitation candle socket of the fitting, and B the gas supply nipple. C is a diffuser mounted in the upper part D of the tubular carrier D D¹; the diffuser being provided with notches to facilitate the screwing of it into position in, and its removal from, the carrier. The part D¹ of the diffuser carrier has a screw connection with the nipple, and the upper part D is provided with the milled flange to facilitate the screwing and unscrewing of the carrier on the nipple. The lower part of the tube E E¹ is larger than the upper part on which the imitation candle K is fitted, and it has air admission holes in it so as to constitute the bunsen portion or mixing-chamber proper of the burner.

The regulation of the air supply is effected by the flanged ring G G¹, with holes therein corresponding to the holes in the part of the tube on which it fits. The flange of the air regulator is slightly dished, and of a size proper to represent the "save-all" of an ordinary candle holder or socket; and the flange constitutes a convenient means for rotating the air supply regulating ring of the burner.

The imitation candle receiving tube E has preferably a series of slits in it, or else is made with a spring tongue or tongues to ensure a steady fit of the imitation candle K on the tube. The china tube resembling the wax candle is preferably provided with a tube closed at its upper end except for a series of small holes constituting a secondary diffuser.

Automatically Operating Gas-Lamps.

OLIVER, C. R., of West Kensington, W.

No. 23,993; Oct. 21, 1912.

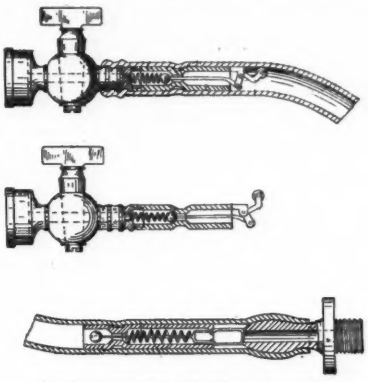
This invention relates to further improvements in apparatus for automatically operating the taps of gas-lamps at predetermined times as set forth in patent No. 23,789 of 1911; and it has reference more particularly to those parts for setting the apparatus to operate at the predetermined times and those associated with the starting and releasing mechanism of the second train, and employed to operate the tap. By means of the improvements, it is possible to set the pointers more readily, and reduce considerably the number of parts of the apparatus —so diminishing its cost.

Gas Supply Pipes or Taps and Connections.

EFFLINGER, R., KRENEK, J., and LECHNER, R., of Vienna.

No. 28,734; Dec. 20, 1911.

This invention relates to means for preventing any escape of gas when a rubber pipe attached to a gas-fitting slips unintentionally off. The device consists of a spring-operated valve attached to the mouthpiece of the pipe or tap and adapted to be opened when the rubber pipe is put on, while, when the latter slips off, the valve is automatically closed by the action of a spring. The device might be arranged



An Austrian Flexible Pipe Connection.

at the end of the rubber pipe connected with the apparatus to which the gas is to be supplied, in which case the valve is within the rubber pipe itself. The accompanying illustrations—a longitudinal section through the tube as attached to a tap, in the open position of the valve, and with the valve closed after the rubber pipe is slipped off—sufficiently indicate the proposal.

APPLICATIONS FOR LETTERS PATENT.

317.—HINKS, J., AND SON, LTD., and HINKS, L. S., "Gas-fittings." Jan. 6.
416.—FISHER, W. H., "Chandeliers." Jan. 6.
476.—COUSIN, P. A. J., "Gas-furnaces" Jan. 7.
488.—STOTT, J., "Gas-governors." Jan. 7.
500.—TAIT, G. M. S, "Gas-producers." Jan. 7.
508.—BEVILLE, W. J., "Improving the illuminating effect of gas-lamps." Jan. 7.
530.—SMITH, G., "Automatic gas-stove." Jan. 8.
569.—ARMSTRONG, J, "Extraction of liquids or solids from gases." Jan. 8.
581.—WHITE, F. C., "Governor." Jan. 8.
606.—HUMPHREY, A. A., "Carburetting air." Jan. 8.
644.—TROTTER, A M., "Automatically extinguishing gas." Jan. 9.
694.—COCKEY, F. G., "Prepayment meters." Jan. 9.
695.—WALTER, E., "Gas branding machine." Jan. 9.
703.—EASTERFIELD, T. H, "Production of ammonium sulphate." Jan. 9.
716.—SAUNDERS, E., "Cocks and taps." Jan. 9.
722.—MAULE, C. F., "Simultaneous production of nitrogenous compounds and combustible gas." Jan. 9.
744.—LYMN, A. H., "Washing gases." Jan. 9.
778.—FOWLER, C. H., and MEDLEY, E. A., "Treating gases with liquids." Jan. 10.
834.—KOPPERS, H., "Producing sulphate of ammonia." Jan. 10.

Public Lighting in France.—According to "L'Electricien," out of 10,000 townships in France having more than 1000 inhabitants, about 6000 are without any public lighting. Of the remainder (4094), there are 1249 lighted by gas, 2673 by electricity, and 172 by acetylene.

Quality of the Gas at Hebburn.—The question of the quality of the gas supply at Hebburn was raised at the monthly meeting of the Urban District Council, when Mr. Holmes said that there was much grumbling by some of the large consumers and householders. He expressed the opinion that the lighting was much better before mantles were invented than it was at the present time. One reverend gentleman stated that some time ago he made an attempt to get a better supply for his church, but was told that the quality was in accordance with the requirements of the Act of Parliament. It was unanimously agreed to send a complaint to the Gas Company.

Supply of Gas-Cookers at Salford.—At an adjourned meeting of the Salford Town Council last Wednesday, the question of supplying, fixing, and maintaining gas-cookers free of charge in the borough was discussed at some length. Mr. Steele, who introduced the subject, argued that in the adoption of this policy lay the success of the undertaking in the future. It was in operation in the Manchester area, where there were nearly 60,000 cooking appliances to 117,000 consumers. In Salford, the figures were only 6000 in 40,000 consumers. In the subsequent discussion, Mr. Steele agreed that the scheme should extend to the whole of the Salford gas area, and Mr. Greenwood produced statistics to show the rapid advance made in the use of cookers in Manchester and Glasgow by the inauguration of the policy of free fixing and maintenance. Alderman Phillips, the Chairman of the Gas Committee, suggested that the matter should be referred to his Committee, who were considering other proposals going much further on the question. After lengthy discussion, the Council agreed to adjourn the matter until the meeting next month, when the Gas Committee will present a report.

LEGAL INTELLIGENCE.

SKEGNESS GAS COMPANY AND ILLUMINATING POWER.

A Summons Dismissed.

At the Spilsby Police Court, on Monday of last week—before Mr. W. D. GAINSFORD (Chairman), Major MASSINGBERD, and Mr. HARRY WALKER—the Skegness Gas Company were summoned at the instance of the Skegness Urban District Council for having supplied, on Oct. 11 last, gas of less candle power than that required by their Act of Parliament—viz., 14 candles.

Mr. C. E. DYER (instructed by Mr. H. K. Bloomer, of Grimsby) conducted the prosecution; and Mr. PERCY R. SIMNER (instructed by Mr. T. E. Maynard-Page, of Messrs. Tweed, Stephen, and Co., of Lincoln) represented the Gas Company.

Mr. DYER, in opening the case, pointed out that the Company were obliged to provide a testing apparatus, and to supply gas of not less than 14-candle power. In the event of the supply not being up to the required standard, the Local Authority were obviously the proper body to make a complaint of this character. Mr. Fairweather, an expert gas tester appointed by the Council, had made a test, the result of which showed an average of 12·2-candle power. When Mr. Fairweather went to the gas-works, he was told that the Manager was out; and the foreman said he was informed that, if anyone wanted to take a test, six hours' notice must be given. Mr. Fairweather waited, and afterwards went with the Manager over the works, when he noticed that the testing apparatus was quite new. He warned the Manager that the gas was deficient, and said he would come back again later, and make a further test. At 8 p.m. he went again, and made three careful tests; and it was in respect of these he would ask the Magistrates to say they had made out their case. The average of the three tests showed an illuminating power of 12·2 candles, which was a considerable shortage compared with the 14 candles required Though it might seem a heavy liability to the Company, there were great privileges bestowed upon it, as they had a monopoly so long as they discharged their work properly. It was only reasonable that, in return for the monopoly, they should strictly comply with the obligations that were placed upon them. The tests were taken at a time when nothing was known of the examiner coming.

The CHAIRMAN said if the inspector had carried out his inspection according to the Act, they must take the result *primâ facie*.

Mr. *James H. Fairweather*, the Council's gas tester, was the first witness called. On Oct. 11 he visited the gas-works, he said, about 3 p.m. In the absence of the Manager, he saw the foreman, who said his instructions were that six hours' notice must be given before a test was applied. Witness pointed out that no such requirement was specified by Act of Parliament. Subsequently, the Manager arrived, and rendered every assistance in making a test. It was evident that the testing apparatus had not been previously used, and the Manager said: "To tell the truth it has only been on the works two or three days." Witness asked, "How long have you been constituted a Gas Company?" "About thirty years," replied the Manager. Witness responded: "Do not you know you have been violating an Act of Parliament all the time?" Proceeding, Mr. Fairweather described how he had conducted the test about 4 p.m., which showed 9·6-candle power. When he acquainted the Manager with the results, he said "I am surprised at that; you floor me entirely." The Manager went and looked at his jet photometer, which he said recorded between 17 and 18 candle power. Witness informed the Manager that he would take another test the same evening, and he returned to the works at 8 p.m., when he again met the Manager. He made three tests, each being ten observations per minute, as follows:

Time.	Candle Power.
8.18 p.m.	12·0
8.34 ,,	12·2
8.57 ,,	12·4
Average	12·2

The Manager was very downhearted about the result. Witness reported the result of the second test to the Council and the Company. In making the test, witness complied with all the statutory requirements so far as circumstances permitted.

Cross-examined by Mr. SIMNER, witness said he did not think it unusual for the candle power to rise between 4 and 8 p.m. He considered 9·6 candles an abnormally low result. He knew the statutory hours had not commenced when he called at the works. He had made many tests as assistant to Mr. W. C. Young, as Gas Examiner, and had also tested the gas of the Brentford Gas Company on behalf of that Company. Asked by Counsel whether, if the Brentford photometer had been received from the makers after being repaired and was newly fitted up, he thought a test after a few hours would correctly represent the quality of the gas, the witness said it probably would not. In reply to Counsel, he said it might be depreciated by 2 candles. He measured the chimney, and found it about 1¾ inches inside diameter. He was not aware that the dimensions should be 1¾ inches outside diameter. Asked as to the difference between a test made on a No. 1 "London" and a No. 2 "Metropolitan" argand, witness said it would be 2 candles. He was aware that the Skegness Act said the burner was the No. 1 "London" argand or other burner approved by the Board of Trade; but he made his test with the burner provided—a No. 1 argand.

The CHAIRMAN: Is it not the business of the Gas Company to provide the apparatus?

Mr. SIMNER: Yes, to an extent.

The CHAIRMAN: I understand that the tester took the apparatus provided. Whether it was good or bad depends upon the Gas Company, and not upon him.

Witness: Quite so, Sir. [Laughter.]

The CHAIRMAN (to Counsel): You provide the apparatus. Are you at liberty to say it is a bad one?

Mr. SIMNER: To some extent I am; but it would be a separate offence.

The CHAIRMAN: It is strange discrediting your own instruments.

Mr. SIMNER: I am not doing so. It is my case that the instrument was properly provided; but, owing to the circumstances, the test did not properly represent the true illuminating value of the gas.

Witness, in reply to some further questions put to him by Mr. SIMMER, said on the occasion of his visit, he made tests with regard to purity and pressure, and reported that the Act was complied with in respect to both.

Re-examined by Mr. DYER, witness stated that where the No. 2 "Metropolitan" burner had been used for tests, the companies had to obtain sanction by Act of Parliament.

This closed the case for the prosecution.

In defence, there was called.

Mr. *Edwin James Brockway*, who said he was Engineer and Manager to the Cleethorpes Gas Company, Managing-Director of the Woodhall Spa Gas Company, and Consulting Engineer to the Skegness Gas Company. He stated that, considering the new condition of the photometer and connections, the burner should have been alight constantly for from twelve to eighteen hours before a test was made. The air in the pipes, and fresh water in the meter and governor, would tend to affect the illuminating power from 2 to 3 candles. The works and plant were in first-class order, and the coal used (Strafford and Aldwarke Main) was the best South Yorkshire Silkstone coal. It was impossible, with the method of working employed, to produce gas from this coal of a lower illuminating value than 14 to 15 candles. The jet photometer would indicate within 1 candle high or low compared with a standard photometer. Considering the conditions with respect to the new installation of the photometer at the time of the test, the result of this (12·2 candles) indicated the true value as well over 15 candles.

Cross-examined by Mr. DYER, witness said that the illuminating power was satisfactory, and he had never heard of any complaints from the Council. The Manager had informed him of complaints from consumers respecting poor lights. The jet photometers, of which two were in use, were rated by him at regular intervals on his standard photometer at Cleethorpes.

Re-examined by Mr. SIMNER, witness said that if the Manager had told Mr. Fairweather that the photometer had only been on the works two or three days, this was not correct. The photometer had been supplied for three months, and he had frequently urged the Manager to fit it up. The Manager had resigned his position, and was not now in the service of the Company. He had never known a gas company against whom there had been no complaints of "poor lights." These were invariably due to choked burners or broken mantles.

George Simmons, a fitter, said that, acting upon instructions received from the late Manager, he connected the photometer by a new length of 1-inch pipe to the town supply main, on the morning of Oct. 11—the day upon which the Gas Examiner made his test.

Mr. *R. G. Shadbolt*, of Grantham, said he visited the Skegness works on Jan. 1, and found the plant adequate; a contract having been placed for another large gasholder. Twelve hours, and even longer, was necessary with a new photometer before making a test, because the air took a considerable time to drive out. The presence of fresh water would also detract from the illuminating power. Abnormal circumstances had tended to produce the result of 12·2-candle power; and a fair test would have revealed an increase of at least 3 candles.

In cross-examination, witness affirmed that the average yield of 11,000 cubic feet per ton of the Strafford Silkstone coal rendered it impossible for the candle power to be so low as 12 candles.

Mr. *Jacques Abady* was next called to give evidence; but the CHAIRMAN gave as his opinion that a lot of evidence irrelevant to the case was being introduced. Personally, he was quite satisfied that the tester and plant throughout were up-to-date. The point at issue was: Was the gas supplied on the date in question up to the standard specified by law or otherwise? The prosecution had proved that the power was only of 12·2-candle strength; it was therefore for the defence to prove that the candle power was 14. Could the defence prove this?

Mr. SIMNER: That is what we are endeavouring to do.

The CHAIRMAN: Well, none of the evidence for the defence has gone to prove that yet. Your experts have argued that, having regard to the plant and coal used, the illuminating power should have been 14-candle strength; but, on the other hand, we have conclusive evidence that it was not. If you can satisfy us that you were supplying gas of 14-candle power, you win your case.

A long argument ensued between the Chairman and Mr. Simner.

Mr. *Abady*, in examination by Mr. SIMNER, then stated that the Company's Act required them to provide a photometer and the gas examiner to make a test as an impartial and competent person. In both these capacities, the examiner was expected to see that the test properly represented the quality of the gas being supplied to the consumer. He (witness) stated that if, as the evidence showed, the photometer was connected on the day of the test, the instruments filled with fresh water, and the gas lighted about 3.30, he was convinced that the result of a test made on that day would be at least 2 candles too low. The gradual increase in the results from 9·6 to 12·0, 12·2, and 12·4 candles showed that the photometer was not used under the proper conditions necessary for an accurate test. The London County Council some years ago had tried to introduce a portable photometer, and brought evidence to show that this photometer, though exactly the same as that in a testing-place, gave results considerably lower. This was because the "conditions" were unsuitable. The Parliamentary Committee refused to sanction the use of a portable photometer for statutory tests. He had no hesitation in saying that, considering the circumstances, the gas at Skegness on Oct. 11 must have been 14 or 15 candles.

Mr. SIMNER, addressing the Bench, submitted two points of law—firstly, that the examiner's report was not sufficient under the Act, and, secondly, that the gas examiner had not weighed the candles before and after each test.

On both these points, the Bench decided against him.

Mr. SIMNER, proceeding, said it was the duty of the prosecution to

satisfy the Magistrates that the gas was below the specified candle power. The words of the section were: "If it shall be proved to the satisfaction of any two justices . . . that on any day the gas supplied by the undertakers is under less pressure, of less illuminating power, or of less purity than it ought to be." It was true that the Act in another section referred to the quality "at the testing-place;" but he urged that what the testing clauses were designed to secure was that the Gas Company sent out from its works to the consumer gas of the requisite quality. They had heard the evidence of Mr. Brockway who, as Consulting Engineer to the Company, spoke as to the sufficiency and proper condition of the plant; nor ought they to disregard the evidence, firstly, of the gas examiner, who admitted that the photometer was newly connected, secondly, of an independent engineer like Mr. Shadbolt, who testified to the impossibility of making gas from the coal used and of the quantity per ton made, of less quality than 14 candles, and, thirdly, of an expert of the reputation of Mr. Abady, who was confident that the conditions of the test were such as to reduce the real illuminating power of the gas supplied to the testing-room by at least 2 candles. The Gas Company were the defendants, and he claimed that he was entitled to have the summons dismissed unless the Bench were prepared to disregard the evidence of his witnesses and say that they were satisfied beyond all reasonable doubt that there had been a default in illuminating power. He would point out that the examiner was required to test for three things—pressure, purity, and illuminating power; and the two former he found satisfactory, while the test on the third point, Counsel urged, was an unfair one. He therefore submitted that his evidence had not only shown that there was some reasonable doubt but that the gas was, in fact, of an illuminating power exceeding 14 candles on Oct. 11, and he asked the Bench to dismiss the summons.

Mr. *Fairweather*, recalled, agreed with the Chairman that the rates of increase of illuminating power between 4 p.m. and 8 p.m. was similar to that between the three last tests. He had no suspicion that the machine was not working properly.

Mr. DYER said he had evidence to bring, if required, regarding complaints respecting faulty illuminating power.

Mr. SIMNER said he could bring plenty of witnesses who would say the power was everything to be desired.

The CHAIRMAN: I do not think it turns upon that at all. It turns upon the sufficiency of the examination on this occasion.

After retiring for a few minutes, the Magistrates returned into court, when

The CHAIRMAN said they were not satisfied that the test was a satisfactory one. They believed that if the test had been made after twelve hours, instead of five, different results would have been obtained. The case would therefore be dismissed; no order being made regarding costs.

THE NATURAL GAS AND PETROLEUM CIRCULARS.

Further Police Court Proceedings.

At the Tower Bridge Police Court on Saturday Mr. Gill continued the hearing of the summonses against the Leadenhall Press, Limited, for printing certain booklets and circulars without imprint, and for publishing and dispersing (or assisting to disperse) them; and against Edmund Eaton, Colonel the Hon. Hubert V. Duncombe, D.S.O., and Daniel Wallace Heims for aiding, abetting, counselling, and procuring the printing, publishing, and dispersing of the documents. On behalf of the Leadenhall Press a plea of guilty had been entered to all the summonses; the other defendants had pleaded not guilty. From the earlier proceedings, which were reported last week (p. 116), it appeared that the summonses were taken out in respect to certain booklets, the outer cover of which read: "Interesting particulars relating to the remarkable discovery of gas and petroleum in the South of England. Oil deposits in the South of England to be tapped for the future full supply of England's needs." On the inner page was: "The South of England Natural Gas and Petroleum Company, Limited," and below this "Chairman, Admiral Lord Fisher, G.C.B., O.M., G.C.V.O.," and a list of the members of the Royal Commission on the Fuel Supply of the British Navy. The fact that these gentleman represented the Royal Commission was printed in small type. The booklet contained an "Encouraging speech by the Chairman of the South of England Natural Gas and Petroleum Company (Colonel the Hon. H. V. Duncombe, D.S.O.)," and a report by "D. Wallace Heims, Consulting Engineer, Technical Institute, London, S.W." Another publication which was put in evidence was a circular, in imitation type-writing, headed "Anglo-Russian Liquid Fuel Syndicate, 6, Abchurch Yard, Cannon Street," and signed "H. Hollis, Secretary *pro tem.*," containing an offer of preference and ordinary shares in the South of England Natural Gas and Petroleum Company, Limited.

Mr. R. D. MUIR appeared for the Director of Public Prosecutions; Mr. CURTIS BENNETT, for the Leadenhall Press; Mr. CECIL WHITELEY, for Colonel Duncombe; and Mr. E. A. HARNEY, for Eaton and Heims.

Mr. WHITELEY said that Colonel Duncombe desired to plead guilty to these summonses, and was most anxious at the earliest moment to go into the witness-box. At a later stage, he would give the reasons why the Colonel had taken this course.

Mr. *W. A. Meers*, a commercial traveller employed by the Leadenhall Press, said the order for the printing of the booklet was given to him by Heims, who wrote from Crown Chambers, Regent Street, on behalf of the South of England Natural Gas and Petroleum Company. Witness saw Eaton, and asked him what he knew of this Company, as his firm had heard that its credit was not good. Eaton said he knew Colonel Duncombe and Heims, and that he had been commissioned by them to sell some bonds in the Company. Eaton also said that his firm might be able to get Colonel Duncombe's personal guarantee if they wrote to him. Later Heims told him that Colonel Duncombe would give his personal guarantee; but the Leadenhall Press afterwards gave up their demand for it, because they could not get it. Subsequently, in his presence, Colonel Duncombe and Heims, as Chairman and Secretary respectively, signed an order for 10,000 booklets, to be delivered in lots of 2000 each; £5 to be paid for each lot on delivery. Early in November, Heims wrote giving instructions as to the printing of the circulars, which, issued by the Anglo-Russian Liquid Fuel Syndicate, were to sell shares in the South of England Natural Gas and Petroleum Company. On Nov. 22, instructions were given by the South of England Natural Gas and Petroleum Company for the delivery of 2000 booklets and 2000 circulars to the London Industrial Contract and Finance Syndicate; and in a letter on Nov. 30, Heims requested delivery of 8000 booklets and the remainder of the circulars to "our agents, the Anglo-Russian Liquid Fuel Syndicate." Payment was made by post-dated cheque, and Heims afterwards asked that this should be held over. The cheque was held over until Dec. 18, and was returned on two occasions, and had never been met. This cheque was signed by Colonel Duncombe and Heims as Directors of the South of England Natural Gas and Petroleum Company, and counter-signed by Heims as Secretary. On Dec. 23, the Leadenhall Press wrote to Colonel Duncombe, drawing his attention to the fact that the cheque had been dishonoured, and that it was only because the cheque was handed over that their representative left the goods. The letter said: "The means employed to obtain possession of these goods are most discreditable." The greater part of the work sent out by the Leadenhall Press consisted of catalogues, leaflets, and general stationery, on which an imprint was not necessary. Apart from his signature on the order and on the cheque, Colonel Duncombe had no correspondence and no transactions with the firm. The omission of the imprint was not an oversight; and it was entirely due to his firm that it was not there.

Other witnesses having been called,

Mr. HARNEY intimated that he did not propose to call either Eaton or Heims, and went on to argue that separately it was no offence to print without imprint and no offence to publish or to disperse without imprint. The only offence under the Act was one that a printer, and a printer alone, could commit—to print matter intended for publication without putting an imprint on it, and then to publish or assist to publish the same matter. Clearly his clients had neither printed nor aided, abetted, counselled, and procured the printing without imprint. Both Eaton and Heims assisted in the circulation of the documents; but where was the evidence that they circulated them knowing that there was no imprint, or that they knew the imprint to be necessary? They had given, on the face of the documents, more information as to themselves than could have been given in an imprint. It had been made a subject of comment that the name of Eaton did not appear on either document; but he was not a Director, and his name could not appear. Of the three defendants, Colonel Duncombe was socially the most important, and Heims was the active worker. Eaton was a company promoter, and, he supposed, was getting something out of the deal. Heims prepared the document, and put in it his report; Colonel Duncombe's name appeared as Chairman of Directors. Heims sent it to the Leadenhall Press without instructions to do anything out of the ordinary. Counsel agreed that the booklet, with its large and small type, was improperly drawn; but his clients stopped the circulation of it as soon as it was brought to their notice and they found it misled people.

Mr. WHITELEY said Colonel Duncombe did not see the booklet, and had nothing to do with it.

The further hearing of the case was adjourned.

THE GRAETZIN LAMP AGENCY.

Important Trade Action.

Mr. Justice Scrutton, sitting in the King's Bench Division as Commercial Judge, was occupied three days the week before last, and on Monday of last week, hearing an action—*Braunstein v. Graetz*—arising out of an alleged breach of agreement of agency for the sale in this country of gas and electric lamp fittings.

The plaintiff (for whom Mr. Duke, K.C., appeared) was Mr. Bernard Braunstein, carrying on business in Carthusian Street, City, as a manufacturer's agent; and defendant was Mr. Max Graetz, of Berlin, trading under the title of Ehrich and Graetz, as a manufacturer of gas and electric lamp fittings. He is also the patentee of the well-known Graetzin lamps. An agreement was entered into some years ago between the parties, under which the plaintiff was to have the exclusive right, for a period of years, to the sale of the defendant's goods in this country; and it was in respect of a breach of this agreement that the plaintiff claimed damages. What happened, said Counsel, was that the defendant had himself set up in business in this country, by forming a limited company to carry on the business of which the plaintiff was to have the sole agency. At the beginning of 1907 the agreement was entered into under which the plaintiff was to have the exclusive agency for the sale of the defendant's lamps and fittings. The business was successful, and a large trade was done. In December, 1908, the defendant, who had become patentee of the new metallic filament lamp called the Graetzin, approached the plaintiff with a view to his taking up the agency for the sale of this lamp. An agreement was entered into under which, if the plaintiff was able to sell in this country £5000 worth of Graetzin lamps within a year from the time he received the final samples, he should have the exclusive agency for two years; and if in the course of the second year he was able to make sales to the extent of £10,000, he was to have the exclusive right for a further period of five years. The success of the plaintiff made him entitled to the full period; and his term would not expire until June, 1916. The event which put an end to the agency occurred in the summer of last year. In the electric lamp business, it was necessary to be on the market in the spring of the year; but the defendant had not the samples ready in time to give him a fair chance of doing a substantial business. Agreements were made by the plaintiff with other firms; but they did not interfere with his business. It was arranged with Messrs. Krupka and Jacoby that they should take up an agency, but their results did not come up to the minimum, and subsequently the defendant arranged

with them that they should form an English Company to take up the whole of the business in England, including the business then being carried on by the plaintiff, and that they should have the sole agency for the sale of the defendant's lamps. In August of last year, the defendant wrote to the plaintiff a letter purporting to cancel his agency and informing him of the agreement with Krupka and Jacoby, and requesting him to cease taking orders.

For the defendant, Mr. Atkin, K.C., in answer to the Judge, said, in the first place, he contended that there had been no breach of agreement, and that the plaintiff had not duly performed all the conditions under the agreement. The agreement with Krupka and Jacoby, he contended, was no breach of agreement between the plaintiff and the defendant, and the defendant had always been ready and willing to employ the plaintiff. He further held that the German law did not recognize such a thing as sole agency.

The plaintiff was called, and gave evidence bearing out his Counsel's statement. He described in detail the circumstances under which the agreement was entered into, and stated that at the time he was introduced to the defendant in 1906 he was doing business in England to the extent of 100,000 marks a year. In 1908, he was first approached with regard to taking up the agency for the defendant, and he afterwards negotiated a sub-agency with the Welsbach Company for the sale of the lamps. He complained that he did not receive the price lists and samples until it was too late for him to take advantage of the season. In cross-examination, he said that the business was by no means an easy one to introduce, as others had possession of the market before him.

In opening the defendant's case, Mr. Atkin said that the plaintiff was not long in discovering that he could not do much unless he could get the lamps known in the market, and he was therefore willing to fall in with the suggestion that Krupka and Jacoby should be allowed to take up the business. The agreement with Krupka and Jacoby was, in fact, negotiated by the plaintiff; and it was a term of the arrangement that his commission should be 2½ per cent., instead of 3½ per cent. There had been no breach of agreement; and as regards commission, none, he said, was due at the time the writ was issued.

Evidence was given by the defendant and his General Manager, by whom it was said that no complaint was made as to the non-receipt of prices and samples. The Manager admitted, in cross-examination, that the prices submitted to Krupka and Jacoby were not the same as those submitted to the other accepted firms. He also said that there was no difference between the stamped and the non-stamped Graetzin lamps, and that the supply of the former to England was much larger than that of the latter. He was unable to deny that a reduction of 10 per cent. in the price of 16 to 50 candle lamps had been made to Scott, Abbott, and Co. some time before the plaintiff was informed of the fact.

Expert evidence having been given as to the bearing of the German law upon agencies, his Lordship, in the result, reserved judgment.

Former Gas Company's Secretary Charged with Fraud and Perjury.

At the Bow Street Police Court last Friday, before Mr. Curtis Bennett, Robert Henry Rushforth, Solicitor and Clerk to the Justices at Amersham, Bucks, was charged on remand with forging and uttering four receipts for the payment of money due to shareholders in the Amersham Gas Company, of which he was the Liquidator. The defendant was further charged with committing perjury. The case was reported in the "JOURNAL" on Dec. 31 and the 7th inst. Mr. D. F. Myers, formerly the holder of eight £5 shares in the Amersham Gas Company, deposed that a receipt [produced] for £40, purporting to have been signed by him, was a forgery. Evidence was then given that on Aug. 17, 1910, the defendant paid into his account at the Union of London and Smiths Bank, Chesham, a cheque for £2635 drawn by the Uxbridge Gas Company, who had taken over the business of the Amersham Company. On Sept. 2 last, his account was £15 4s. 5d. in credit. On Sept. 20, £305 was paid in, and £70 on Oct. 2, besides smaller sums on other dates. Mr. A. House, of the Board of Trade, who had charge of the liquidation proceedings of the Amersham Company, said that on June 14 last the defendant filed a statement of account showing that there was £215 due from him to ten shareholders. After the receipt of this account, two letters were sent to the defendant asking him to pay over the money he had in hand; but no reply was received to either of them. Mr. N. G. Newington, from the Solicitors' Department of the Board of Trade, said that on July 13 last an order was made by Mr. Justice Swinfen Eady requiring the defendant to pay the money due from him within four days. The order was not complied with; and on further proceedings being taken, on Sept. 11 he swore an affidavit in which he stated that he had distributed the greater part of the £215, and that the sum then in his hands or under his control was £27 18s. 2d. He also produced eight receipts purporting to be signed by eight shareholders in the Amersham Company; among them being the four which had been referred to in the case. As a result of inquiries, a writ of attachment was issued, and the defendant was imprisoned from Oct. 1 to Oct. 15, when he was released, having satisfied the Board of Trade that the whole of the money due from him had been paid. The hearing was again adjourned.

Proposed Adoption of Vertical Retorts for Macclesfield.—At last Wednesday's meeting of the Gas Committee of the Macclesfield Corporation, considerable time was spent discussing the question of the introduction of vertical retorts. A report by Mr. W. Newbigging showed that the probable cost would be £15,750; but against this there would be an estimated saving of £2500 a year in labour, &c. It was stated by the Borough Accountant that the Gas Committee's borrowing powers were practically exhausted, and that a new loan would be required. It was finally decided to call a special meeting of the Committee prior to the February meeting of the Council to discuss the matter more fully.

MISCELLANEOUS NEWS.

SIDMOUTH GAS-WORKS PURCHASE ARBITRATION.

The Case for the Sellers.

Proceedings were commenced last Thursday, and continued on subsequent days, at the Surveyors' Institution, Great George Street, S.W., in an arbitration to determine the price to be paid by the Sidmouth Urban District Council for the undertaking of the Sidmouth Gas and Electricity Company. The case for the Company is reported to-day; and an account of the remainder of the proceedings will appear in next week's issue.

Mr. A. J. RAM, K.C., officiated as Umpire; and there sat with him as Arbitrators Sir CORBET WOODALL, D.Sc., for the Company, and Mr. C. C. HUTCHINSON, K.C., for the Council.

The Counsel appearing were Mr. G. M. FREEMAN, K.C., and Mr. W. J. JEEVES (instructed by Messrs. Torr and Co.) for the Company, and the Hon. J. D. FITZGERALD, K.C. (instructed by Messrs. Baker and Co.), for the Council.

OPENING OF THE CASE.

Mr. FREEMAN, in opening, said that the Company who were to be bought were incorporated by an Act of 1911, which dissolved the Sidmouth Gas Company, Limited, and re-incorporated the members of it under the new name of the Sidmouth Gas and Electricity Company; the purposes declared being, among others, the manufacture and supply of gas in the parishes of Sidmouth, Salcombe Regis, and Sidbury, to generate and supply electricity within the said parishes, and to manufacture the usual bye-products. The gas-works were originally established under a Provisional Order of 1874; and the capital was not to exceed £15,000. Mr. John Dunning carried on the business until his death, about 1885; and in 1886 the property was offered for sale by auction at Tokenhouse Yard, and was purchased by Mr. T. Douglas, who afterwards became Chairman and General Manager of the Company for life. Mr. Douglas then proceeded to create the Sidmouth Gas Company, Limited. The £15,000 original authorized capital was divided into 1500 shares of £10, of which 300 were called "A" shares, and had preferential rights. Then, by a resolution in May, 1900, the capital was increased to £18,000, the addition being 300 £10 "B" shares, with preferential rights. The Company also had power to borrow £2000 on debentures at 6 per cent., and were restricted from borrowing beyond this without the sanction, not merely of a general meeting, but of a Director elected by the "A" shareholders. The Company borrowed the £2000, and had since, with the proper authority, raised another £3000, bearing interest at 4½ per cent. The holders of the "A" shares were entitled to a preferential dividend of 5 per cent., and they had also the right to resort to the profits of subsequent years for the payment of back-dividends. The residue of the profits was to be applied first to the payment of a dividend of 5 per cent. on the ordinary shares; next in paying rateably a further dividend of 2½ per cent. to all the shareholders, both preference and ordinary; and the remainder of the profits was to be distributed among the ordinary shareholders. Since the purchase of the property, large additions had been made. A great many mains had been replaced, and two gasholders had been erected. There were now over 10 miles of mains. Retorts and other plant had been increased and modernized; and a sulphate of ammonia plant had been erected. The works generally were highly spoken of by witnesses for the Council who were in Parliament, both as regarded their state of efficiency and their capacity for doing a great deal more business than they were at the present time. The Company had purchased cottages upon land adjoining for the accommodation of their workmen, and they had ground available for future extensions. At first the price of gas was 6s. 3d. per 1000 cubic feet, but it had now been reduced to 4s., with 3s. 9d. for cooking, and 3s. for power. The profits had always been sufficient to pay the interest on the borrowed money and the preferential dividend of 5 per cent. on the "A" shares; but in the early days no proper dividends were payable on the ordinary shares. Sometimes they got only 2 per cent., and at others nothing; but since 1903 the maximum dividends had been paid without intermission—7½ per cent. on the "A" preference, 4½ per cent. on the "B" preference, and 10 per cent. on the ordinary shares. The gas sold in 1911-12 to private consumers was 17,919,000 cubic feet, and for the public lighting 2,263,500 feet. The development of the business synchronized very closely with the development of Sidmouth itself. Until 1897 it was not a particularly well-managed town from a sanitary point of view; but in that year the sewerage system was reconstructed, brine baths were opened, and the place was extensively advertised. The result was a very rapid rise in the number of visitors and residents; and in the ten years from 1901 to 1911, the population increased by more than 30 per cent.—from 4200 to 5600. The other parishes supplied were also attractive places; and there was every reason to believe that they would rapidly develop. Before the Bill went to the House of Commons, and after it had left the Lords, it was agreed that a purchase clause should be inserted in the Act. This provided that if the Council obtained an Act, the Company should sell and transfer the undertaking subject to all the existing liabilities and obligations, other than mortgage or debenture debts. Failing agreement, the price was to be determined by arbitration in accordance with the provisions of the Lands Clauses Acts. The Council were, in addition, to pay the Company the cost of obtaining their Act. The Council did promote a Bill in 1912, and subsequently gave notice of their intention to purchase. By the Company's Act the standard price was fixed at 4s. per 1000 cubic feet, with the sliding-scale. In conclusion, he explained the method of valuation adopted, which will appear from the evidence.

THE AGREED FIGURES.

Mr. *William Cash* was then called, and examined by Mr. JEEVES. He stated that he had had before him the accounts of the Company since 1886; and he and Mr. W. B. Keen, the Accountant on the other

side, had agreed on the figures which he would hand in. As to the capital and the dividends and interest payable thereon, these were as follows: On £9000 of ordinary, 10 per cent., or £900; on £3000, 7½ per cent., or £225; and on the 4½ per cent. preference, £135—making a total of £1260. On the debentures, the two amounts would be £120 and £135, making £255, and giving a total of £1515. The capital account had been very fairly dealt with; and the Company had written-off quite substantial amounts from time to time when there had been anything in the nature of an expenditure which involved part demolition or alteration. No depreciation had been charged in respect of meters. The practice of the Company had been to write off the repairs; and if a meter was put in as a renewal, that was charged to revenue. There were 167 public lamps, all the property of the Company. Stoves had been written-down to half their cost. In the receipts for public lighting there was a small drop shown the last year. He understood that the lighting was curtailed at the wish of the Council, and against the desire of the Company, at the time of the coal strike last spring. Generally speaking, the results of the past five years showed a continuing improvement each year as they got nearer the last, which was the best of all. The old Company, prior to incorporation with the new Company, paid a back-dividend in December, 1911; and they distributed this as 16 per cent. on the original ordinary (£1440), and 16 per cent. on the preference shares (£195). Even now the dividends that remained unpaid amounted to practically a total of £3350; but this was swept away by the Act of 1911. The make of gas per ton showed a steady improvement, and the leakage had gone down in a quite remarkable way. The Company had undoubtedly been spending money on the repair of mains to some large extent.

Cross-examined by Mr. FITZGERALD, witness said he did not know that Mr. Douglas had purchased the works for £6000, though he sold them to the Company at once for £8030. The residue of the 10 per cent. shares was issued at par in 1909, 1910, and 1911. The net cost for coal went down every year, and the last drop was very large indeed, and was not accounted for entirely by the price of residuals. He admitted that the figures showed that in 1912, when the sale was about to take place, the price of coal was the least for five years, the net cost of coal was very much below the average, and the expenditure on repairs and maintenance considerably below it. The untaxed costs of the Sidmouth Gas Act of 1911 amounted to £2450; and they had actually been paid. There was a bank overdraft of £2704; but he did not agree that if the Council (who were bound to pay the cost of the Act) paid this overdraft they would be paying these costs twice over. The overdraft might have been used for coal stocks and the making of gas, payment for which was still owing to the Company.

Mr. HUTCHINSON: In fact, out of what moneys was the £2450 paid?

Witness: It was paid by drawing a cheque on the Company's bankers; and when you drew the cheque, to that extent you increased the Company's overdraft

So that, in fact, the £2450, by the operation, came out of the overdraft?—Yes. But, of course, when you paid your contractor your last bill, you increased your overdraft.

Mr. FITZGERALD, in the course of subsequent questions, called for the production on the following day of the invoices of coal for the last five years. There was, he said, a particular reason for wishing to see these documents.

In re-examination by Mr. FREEMAN, witness said he did not know whether it had been stated that Mr. Dunning had spent £9710 on the works. He saw nothing improper in the transfer of £800 to reserve, and then the return of this in payment of back-dividends.

EXPERTS' VIEWS.

Mr. *Henry Woodall*, examined by Mr. FREEMAN, said that his firm acted for the Sidmouth Gas Company in connection with their application to Parliament in 1911. He had visited the works and been all round the district. The undertaking was at present working under the powers granted in the 1911 Act, by which the limited Company were incorporated, under the name of the Sidmouth Gas and Electricity Company. The total amount of share and loan capital was fixed at £40,000 under the Act—this being an additional £20,000, including borrowing powers. There was the usual clause relating to reserve and special purposes fund. The standard price was fixed at 4s. per 1000 cubic feet; and the increase or decrease of the dividend was dependent on the lowering or raising of this price. The quality of the gas was fixed at 14 candles by the "Metropolitan" No. 2 burner; and the pressure at 8-10ths. Then there were certain clauses referring to electrical powers. The Company were authorized to supply electricity. He had, however, added nothing to his valuation on account of this, but simply asked the tribunal to have regard for the fact that the Company possessed this power, in order that they might agree with him in his multiplier. They would see that there was no chance of competition. Nothing had been done up to this time in the way of supplying electricity; but witness considered that importance attached to the Company having a monopoly, so to speak, by reason of the fact that the right to supply both gas and electricity was in their hands. To his mind, an undertaking of this character was less liable to fluctuation, and safer even, than a water company. He had carefully considered the accounts prepared by Mr. Cash and Mr. Keen, and obtained a thorough knowledge of the works and district, and on this basis had drawn up a valuation. The Company had carried on the works since securing a Provisional Order in 1874; and so far as he knew, the supply had been satisfactory. He was told there were no complaints either as to quality or pressure. The price of 4s. per 1000 cubic feet was a reasonable one, as was shown by the fact that the increase in consumption had been steady and fairly large. In fact, the growth in consumption for the past ten years had been at the rate of 6½ per cent. compound. It was, he believed, admitted that the works were in very good order; and without additional expenditure they would be able to meet a largely increased demand. He produced a table setting forth the surplus plant—a question which, he reminded the tribunal, was gone into when the Bill was before Parliament. The amount of capital expended by the Company was £19,583; and this was more than represented by the works and mains. To test this, he had prepared a structural valuation, which came out at £23,250—including an amount of land which was not at present used for gas-works purposes. As an instance, he referred to one item in this valuation—the meters. These he had valued at £1261, against an actual figure in the accounts of £900 odd. As he had already said, the works were capable of a considerably increased output; but he took the margin now as being rather smaller than was stated by Mr. E. H. Stevenson when giving evidence for the Council in 1911, as the actual output had grown in the meantime. In reckoning out the capacity of the carbonizing plant, he had allowed for one setting of six retorts being always at liberty. Inasmuch as just now the cost of materials was very high, he attributed great importance to having gas-works in excess of the existing demands upon them. There was ample scope for growth in the district; and assuming the business was properly developed, he reckoned that the output could be doubled in a few years. There was only a small proportion of stoves out; and there was a large percentage of houses that could be supplied with gas. The area of the land belonging to the Company was nearly as much again as that occupied by their works; and it would therefore be easy to provide extensions from time to time as they were required. Having the land, it would be unnecessary to get powers to carry out extensions. All the land he referred to was scheduled either for the manufacture of gas or for the generation of electricity. The total expenditure on repairs and maintenance of works, mains, meters, &c., for 1912 was shown as 5·05d. per 1000 cubic feet; and in his opinion this amount would practically be sufficient to keep the property in its present condition. As a matter of fact, the Accountants were not able to allocate wages and Manager's salary to all the items, and one of them was undoubtedly repairs and maintenance. In the previous year, the amount was 4d. per 1000 cubic feet. Everything was in very good order, and there was no indication that repairs and maintenance had been neglected. Personally, he usually adopted a figure of 6d.; and he thought that if the wages had been properly allocated they would have arrived at 6d. in the present case. In the matter of leakage he found that there had been a very great reduction within the last four years. Now, even, the leakage was by no means low; but it stood at a reasonable amount. Since 1909, when the unaccounted-for gas was shown to have been over 16 per cent., the Company had been giving special attention to this matter, and had brought it down to between 7 and 8 per cent. Many new mains had been laid—some of them in substitution for old ones. With regard to the question of capital, he had prepared a table, from the Board of Trade returns, showing companies in Devonshire, Dorsetshire, and Somersetshire of about the same size as this one; and taking into consideration the value of the surplus works and lands, the capital expenditure of the Sidmouth Company was certainly moderate. In drawing up his valuation, he had as far as possible made his figures agree with those of the Accountants; but he had made some slight variations for the purpose of arriving at the balance available for dividends. He had added a small amount to the item of public lighting, and a certain sum to that of rents. Under the latter head, he had reckoned 5 per cent. as a fair figure on the value of the unused land. In the ordinary course of things, he thought the Directors would have reduced the price of gas 6d. per 1000 cubic feet; but as they were about to be bought out, this would have been an unfriendly act towards the Local Authority, and so the reduction was not made. The Council would derive no advantage due to the sliding-scale from reducing the price of gas; and had the reduction been made, they might have thought it advisable to put the price up again. He had, however, assumed for the purpose of his calculations that from the beginning of the financial year the price of gas had been reduced to 3s. 6d., which entitled the Company to divide another 1½ per cent. On the finances of the year, it could perfectly well have been reduced by this 6d., and given the Company sufficient to pay 11½ per cent. on the 10 per cent. capital. The adjustments he had made brought his revenue to £2350; and deducting from this £505 for the 6d. reduction left £1845. The dividends to which the shareholders would thus be entitled would amount to £1650, so that there was left a margin of £195, with the lower price of gas. This £1650, he thought, was quite maintainable, for various reasons. In fact, he would say that the statutory dividend was more than usually well secured, having regard to all the circumstances of the case. Therefore the multiplier he used was 28½ years' purchase—a figure which was thoroughly justified. He had taken the profits up to the date of the accounts, and had added nothing for prospective profits, unless this reduction of 6d. was so considered. He saw no reason why in due course the price should not be brought down even lower than 3s. 6d. With a large increase in business, the capital outlay per million would be considerably reduced; and there was nothing to prevent the Company selling gas at 3s. in the future, which would mean still another 1½ per cent. dividend. The coal used was nearly all from Somersetshire. As he had mentioned, the repairs and maintenance for 1912 came out at 5·05d. per 1000 cubic feet. Mr. Fitzgerald had pointed out that the average of the last five years was 6·84d. In the first three of these years, however, there were included certain special sums; and if they were taken off (as they ought to be), it would reduce the 6·84d. by 1·89d., so bringing the average down to 4·95d., which would be very much the same as the 5·05d. mentioned for 1912.

Witness then handed in a valuation, which he proceeded to explain. Taking the dividend on the ordinary and preference shares at £1395, and multiplying this by 28½, gave £39,757. Then he had to deal with the two sets of debentures. The £2000 "A" 6 per cent. debentures were terminable in 1916; so that if they were paid off now, it would be 2½ years before they were entitled to be paid. Therefore he arrived at the present value, and gave them the equivalent of the rate at which he valued the undertaking. He assumed the money was going to be invested at 3½ per cent., which was the same as 28½ years, and took 2½ per cent. off the 6 per cent. for 2½ years, which came to £125. Then he applied the same principle to the £3000 "B" 4½ per cent. debentures, terminable in 1924; the only change being that, instead of the difference between 6 per cent. and 3½ per cent., they had to adopt the difference between 4½ per cent. and 3½ per cent., and 11 years instead of 2½ years. The present value of this 1 per cent. was £273. Therefore, adding the £2125 and £3273 to his previous figure gave £45,155. Then he added 10 per cent. on the share capital value

of £39,757, or £3975, making a total of £49,130. In this, he had not included anything for the cost of the Act.

Cross-examined by Mr. FITZGERALD, witness said he did not know what the ordinary shareholders would get if his figures were accepted by the tribunal, because he was not aware what the preference shareholders were to have. It was pointed out to him that under the Act the preference shareholders were only entitled to receive back the amount paid up by them; but he replied that he had understood it was a purely domestic matter, and that these people might have some sort of consideration, though he agreed they could not claim it under the Act.

Mr. FITZGERALD: If the statutory provisions are carried out, what would the holders of the ordinary shares get?

Witness: I cannot tell you without working it out; but it would be about £40.

I make it £42 odd. Before this question of purchase was mooted, what was the highest price at which the ordinary shares had ever sold?—I do not know.

Would you be surprised to learn that as late as 1909 ordinary shares were sold at £13 10s.?—I should be very surprised. It would be a most ridiculous price, that is all I can say.

Has it struck you that, according to your valuation, the ordinary shares in this little Gas Company in Sidmouth are worth a greater number of years' purchase than Bank of England stock?—I know that, but it is not the way I look at it. I say there is the maintainable profit, and it should be purchased at this price. The income I have got here is absolutely maintainable, and, therefore, should be purchased on the 3½ per cent. basis. The Company could sell gas at 3s. 6d. and pay 11½ per cent.; but I say, further, that they could get even lower; and for every 1d. reduction they are allowed to have 5s. per cent. extra dividend. If they stopped at a dividend of 11½ per cent., they could build up an unlimited reserve fund.

Can you give to the tribunal a single gas company at the present time whose shares are being bought and sold on the basis of 28½ years' purchase?—No; but I do not think anybody could suggest that a single transaction between individual shareholders should be taken as the basis for a matter like this. I agree that at present stocks in first-class companies are sold to show about 5 per cent.

Mr. FITZGERALD quoted from a copy of the "JOURNAL" some of the yields on gas companies' stocks, and said the undertakings he had named were first-rate ones, and were all giving yields which worked out at 20 years' purchase or under.

Witness, in reply, said that if there had been no margin to reduce his price, he would have agreed that his valuation was too high; but it was an absolutely safe profit, which could be increased. Further questioned, he stated that in his calculations he had made no allowance for an increased price of coal. If, however, the price of coal went up, residuals would probably realize more. Of course, if the Company were entitled to pay the debentures off at par now, the two additions under this head that he had made in his valuation would come out. His figures were on the basis that the holders could refuse to be bought out now at par. He had added 10 per cent. for compulsory purchase; but he did not know that this had been inserted in the clause and then struck out by agreement.

Mr. FITZGERALD: You have got in the clause the costs of the winding-up and transfer, and now you ask 10 per cent. in addition.

Mr. FREEMAN: All that this means is that, instead of stereotyping this 10 per cent. as an amount which must be allowed by the tribunal, we leave it to them to give what they regard as reasonable.

Mr. FITZGERALD (to witness): Taking 1909, you will find the amount of gas made per ton of coal carbonized was 10,057 cubic feet. In 1912, it increased to the high figure of 10,847 cubic feet. During this period there were the same works, the same manager, and the same coal?

Witness: I rather doubt the same coal; but I do not know. They have always bought coal from a number of people; and they may have had different percentages of the various sorts in the two periods. There is considerable variation in Somersetshire coal. The present make is not at all a high figure, and is one I should expect from a well-found works. The retort-settings are very good, and there is no reason why they should not get this amount of gas out of the coal. Possibly the quality of the gas has been reduced under the new Act. The figures do not necessarily suggest to my mind that there is something wrong with the quantities.

Mr. FITZGERALD pointed out that where there was only a meter supplied to the prepayment consumers, the outside extra price the Company were entitled to charge was 10 per cent. on the cost of the meter; and he suggested that some people had been charged more.

Witness replied that he was afraid this section had been ignored, because some people were charged 5s. 2d. per 1000 cubic feet, whereas the most they could charge under the section was 10d for hire of meter and fittings, or 1s. if the installation included a cooking-stove.

Mr. FREEMAN remarked that this could not affect the previous year. The 1911 Act only came into force on Jan. 1, 1912, so that only three quarters of the year under consideration would come under the terms of the Act.

Witness, answering further questions, said it might be the case that in the great majority of instances it was simply a prepayment meter that was put in. The cost of a three-light prepayment meter would be rom £1 15s. to £1 16s.

Mr. FITZGERALD: If you take this figure, and work out 10 per cent. on it, I think you will find there has been a very considerable overcharge in the nine months of the year under account.

Second Day.

Mr. *Henry Woodall*, further cross-examined by Mr. FITZGERALD, admitted that the increase in the make of gas was less last year than the average of the preceding five years; but there were so many houses unconnected which could be immediately joined up with the mains, and there were so far very few cooking-stoves fitted up. The Company now had an Act, and plenty of money, and would probably do more to secure new consumers than before. It might be a fact that 98,000 cubic feet of gas had been made in a day. He had for his calculations taken the make of gas per mouthpiece at 7000 cubic feet. He had reckoned for a setting to be always at liberty—the least economical. As the requirement for coal storage, he had taken six average weeks' consumption. This was a figure that was generally adopted. About 70 per cent. of the mains were 2 and 3 inch; and looking at the matter at first, he would have said this was not satisfactory. Tests of the pressure throughout the district, however, had proved that it was quite satisfactory.

Sir CORBET WOODALL: In extending the mains, you would, of course, make provision for the future?

Witness replied that if he were relaying the mains, he would do differently; but the supply was quite satisfactory at present. The works pressure, he continued, varied from 2¼ to 3½ inches on a particular day of which note had been taken; and, of course, the gas-works were situated at the lowest level of the town. He believed the Company had undertaken when before the House of Lords to establish the electrical works. It was true that many small electrical works did not pay; but he saw no reason why they should not, especially in the hands of gas companies. The two undertakings might be taken as representing a partnership.

Re-examined by Mr. FREEMAN, witness said there were some big people in Sidmouth who had taken gas for the purpose of generating electricity; and in many cases gas would be employed for cooking and heating and electricity for lighting. It by no means followed that the use of electricity would be destructive to gas; it might be supplemental to it. Many people who took both gas and electricity found that they consumed much more of the former than of the latter. The amount of £42 per ordinary share at which his figures worked out included the 10 per cent. for compulsory purchase; without this the return would be equal to about £37.

Sir CORBET WOODALL: Is it probable that the two undertakings—one for electricity and the other for gas—would be managed more economically if they were both under the same control than if they were run separately?

Witness: Yes.

Then is there any reason why each should not bear the same proportion of profit? Is there any reason why there should be a loss on either?—I see no reason why there should be a loss.

With regard to the small mains, is the proportion of the 2 and 3 inch ones larger than you find generally in towns of this size?—I certainly thought there was a rather large proportion of small mains when first looking into the matter; but after making the tests, and finding there was sufficient pressure, I was satisfied.

Mr. HUTCHINSON: Do you think the net cost of coal is likely to remain 33 per cent. lower than it was in the lowest of the previous five years?

Witness: Yes; I think the present working results can be maintained. It is much to the advantage of the Company that they are able to store their tar. Road people want tar in the summer; and if gas undertakings can hold stocks, they are able to get better prices.

Upon what principle do you arrive at your multiplier of 28½?—It is a very secure income which should be invested in absolutely safe securities to realize the same amount.

What multiplier would you have given if this had been a non-statutory company?—I have generally given 26¾ years; but then you would want to know as to the maintainability of the income.

Mr. *G. H. Appleyard*, the Local Manager of the works, examined by Mr. JEEVES, said he had held his position for over twenty years. Great efforts had been made to reduce the leakage; and these endeavours had been augmented in the last two or three years. They went round the district making a systematic search. The make of gas per ton was much better in 1912 than previous years. Between 1910 and 1911 the make was increased from 10,030 to 10,291 cubic feet; and in the year to September last, there was the still better result of 10,847 cubic feet. This difference he put down to the fact that they used a better class coal; while the improved working rendered possible by the greater gasholder room available also influenced the results. There was no difference in the quality of the gas in the two years. There was a very large increase in the sales of gas in the years 1903, 1904, and 1905; and this was probably owing to the hotels taking a supply for gas-engines. In 1907, 1908, and 1909, the increase in sales was on a smaller scale; and this might have been due to some of the larger hotels taking on suction gas. He attributed much of the former high leakage to the effects of the sewerage works carried out by the District Council.

Cross-examined by Mr. FITZGERALD, witness said that so long as he had been connected with the works, there had only been a jet photometer there. He explained the method he adopted for estimating the amount of coal in stock, which he said could be done fairly closely. If mistakes were made, they were careful that they should be on the right side. The amount of gas made per mouthpiece would be, he thought, about 6500 cubic feet; but he had not worked it out. He remembered telling Mr. Stevenson when he visited the works that a make of 5000 cubic feet was very good, and 4500 cubic feet was satisfactory. They had three beds of seven retorts, and one of six.

Mr. *J. H. Brearley*, of Longwood, examined by Mr. JEEVES, said he had visited Sidmouth and the gas-works in connection with the arbitration. The site of the works was an excellent one; being at the lowest available point in the area of supply. Coal could be brought in by sea or land. In fact, at one time sea-borne coal was used. With regard to the make of gas per retort, he was quite certain that 6500 cubic feet, could be obtained from the settings installed at Sidmouth. Personally, he should have no hesitation in undertaking to produce this amount from them. He had examined the books and had prepared a table showing the maximum make of gas during the last few years; and he had taken as the daily output of the works, a figure of 91,000 cubic feet, which he had arrived at by averaging the maximum week in the past six years. This was a fairer criterion than taking a single day, because the gasholder was there to equalize the variations in demand. The working results were very good. The make in 1912 would compare quite favourably with works of similar size; but, at the same

time, he did not think there was anything abnormal in the make of gas or in the tar or coke. The works were equipped with the best style of regenerative settings; and there was no doubt as to obtaining similar results with the class of coal that was largely used in the year of account. There was a good demand for coke, which was sold entirely locally. It was probable that the whole of the tar would be disposed of in Sidmouth for some years to come. In various respects the plant was considerably in excess of present requirements. In November last, he took the pressures in five or six different places, between 9.30 and 10.30; and the average was 34-10ths—the lowest, he believed, being 27-10ths. At the time he took these readings in the district, the pressure at the works was 30-10ths. In addition to these tests, he arranged to have some charts taken; and he had put down the pressures for each hour of the day over the twenty-four hours. The points selected were the extreme end of a long length of main or in streets where there was a large consumption. The charts conclusively proved, to his mind, that there was no shortage of gas in the town. The storage for tar and liquor was equal to over a year's production. The surplus plant and buildings would be of a value of not less than £2000. He did not in this calculation take into account the surplus land, or any surplus there might be in stores or workshops. This showed that the purchasers would secure a property that had not by any means reached the limit of its earning capacity. The deduction he drew from the continuous decrease in the last few years in the leakage was that great attention was being paid to the mains. In this respect, the undertaking compared favourably with certain of the other undertakings in the same and two neighbouring counties. The reduction in leakage in the year 1912 compared with 1902 was 8·92 per cent. The average leakage in undertakings of from 10 to 15 millions was 7·9 per cent., while the figure at Sidmouth was 7·85 per cent. The length of mains was rather extensive for a works selling only 20 million cubic feet. The leakage per mile of main worked out at 181,000 cubic feet; and the number of consumers in Sidmouth per mile of main was 65, as compared with an average of 112 in the other towns he had taken. The figures relating to other undertakings which he had quoted were taken from the Board of Trade returns, and so referred to an earlier period than those for Sidmouth. The mains and services were in good condition. Within the last five years, the Company had spent £1471 on new mains and services; and if the figures were taken over ten years, the outlay was £2534. Mr. Woodall's total valuation for mains and services was £3851; so that it was quite obvious they must be modern, and in a satisfactory state. No doubt the leakage would be still further reduced. The consumption had in the past ten years nearly doubled; and the rise in rateable value and the growth of the population promised well for the future of the undertaking. Considering the excess works and the small number of consumers, the capital account was quite reasonable. For repairs and maintenance, 5d. per 1000 cubic feet was a very fair figure indeed to take.

Witness then proceeded to explain his valuation, which he said was in some respects on similar lines to that of Mr. Woodall; but he (Mr. Brearley) had added an item for increased sales of gas during the current year. This increase was likely to be 5 per cent.; and it was for the tribunal to decide whether they would allow anything for it. It equalled £125, taking the ratio of profit earned in the year of account; and this would increase the profit to £2475. In his valuation, he first considered the debentures, with which he dealt on the assumption that they were issued at the reasonable rate of interest of 3½ per cent. Generally, money could be raised on debentures by the small country companies at this rate. Taking the matter in this way, the amount required for interest and dividends would be £1435; whereas the adjusted profit was £2475. This left a surplus available for reducing the price of gas and for paying increased dividends of £1040. From this, he had assumed that the price of the gas would be reduced from 4s. to 3s. 4d. per 1000 cubic feet; and in connection with this calculation, he had taken the amount of gas he estimated would be sold during the current year (21,182,000 cubic feet), and at 8d. per 1000 cubic feet this amounted to £706. To this he added a dividend of 2 per cent. extra on the ordinary shares (making 12 per cent.). This equalled £180, and added to the £706 made £886, which, deducted from the balance, still left a net surplus of £154. He had no hesitation in saying that the Company could quite safely reduce the price to the figure he had named. By manipulating the surplus plant and by development, the time should not be far distant when the charge for gas would come down to 3s. He had taken as his multiplier the figure of 28½ years' purchase; and he did so because of the exceedingly bright prospects of Sidmouth, because of the very efficient state of the works, because of the surplus plant available, and because the undertaking was going to be absorbed and the shareholders should be enabled to put their money into absolutely safe securities. It would be hardly possible to find a better security than this. It was better, perhaps, than some of the larger concerns that were subject to competition.

For his valuation, witness took the dividend on the ordinary shares (at 12 per cent.) and the preference shares at £1440, which multiplied by 28·57 years' purchase equalled £41,140. To this he added 10 per cent., £4114, and then for the debentures £5000; making the net amount £50,254.

In cross-examination by Mr. FITZGERALD, witness said he had included in his figures the amount for the sales of fittings, and had multiplied this by the number of years' purchase. The charge for labour was, however, allocated to labour, and so the sum named was not really a profit. He would not be very much surprised to find that his valuation made the shares worth more than Consols.

Mr. FITZGERALD: According to you, there is no security quoted on the Stock Exchange of the same value. If you found a man willing to offer £50,000 for an undertaking of this sort, you would think him fit for a lunatic asylum, would you not?

Witness: I do not think so.

Questioned as to the reason why so many of the houses had not been connected, witness said there must have been some shortage of capital, or some reluctance to issue further capital. If coal went up in price, residuals would go up as well, and it might be to the same extent.

Mr. HUTCHINSON: Do you think that the price which a willing purchaser would give for an undertaking of this kind is any guide to what this tribunal should award?

Witness: I think it would be some guide.

Is there any difference in your mind in approaching this problem between the price to be given on compulsory purchase and the price a willing buyer would give?—I think so, because a willing purchaser comes to buy quite voluntarily, and in the other case the seller is compelled to sell.

And therefore, because he has to sell, he should get a higher price than he would in the market. That is the way you have approached it?—Yes.

Mr. HUTCHINSON: Why I ask is because I have always understood that the price to be arrived at by a tribunal sitting under the Lands Clauses Act was the price that would be given under ordinary circumstances in the open market—of course, without the 10 per cent.

Mr. FREEMAN: I should say the value of a thing was the value to the seller.

SOME LOCAL EVIDENCE.

Mr. *William J. Pidsley*, a house agent and auctioneer carrying on business at Sidmouth, who had acted as Collector to the Gas Company for 26 years, gave evidence as to having valued certain property belonging to the Company, and also as to the issue of certain shares and debentures.

Mr. *W. H. Hastings*, a solicitor in Sidmouth, and Secretary to the Gas Company since 1886, said that the Managing-Director had his house rent free, except for one room (used as a Board-room) and the basement. He gave details as to the number of houses in Sidmouth and the proportion that were supplied with gas, and that could be supplied from the existing mains. There were about 1300 houses in Sidmouth. Those at present supplied numbered 559, and 573 more could be connected with the mains.

In cross-examination, witness said he did not know whether there was a transfer of ordinary shares in 1909; the value stated being £13 10s. He had given certificates for probate, but for this purpose would not attempt to value the shares. He would simply look at the last transfer. Probably the figure put in would have been between £13 and £15.

Mr. FITZGERALD: In 1909, 1910, and 1911, your Company issued a number of ordinary shares—350 of them. The ordinary shares had been paying maximum dividends since 1903. At what price did you issue those shares?

Witness: To the best of my recollection, they were issued at par.

Having issued those shares at par, did the Company, in December, 1911, pay 16 per cent. dividend on them, and what was it for?—Back-dividend.

Was there any back-dividend due in respect of any one of those shares?—No, I imagine not.

Mr. FITZGERALD: And nevertheless, in December, 1911, you paid 16 per cent. dividend on those shares, and called it back-dividend, and this was in addition to the 10 per cent. dividend they were entitled to. So those fortunate shareholders were getting 26 per cent. in the year 1911; and you paid income-tax as well.

Re-examined by Mr. FREEMAN: The last issue of shares was made at par and offered *pro rata* to existing shareholders, who, in respect of their old shares, were undoubtedly entitled to back-dividends. There was shown in the accounts at the present time £3350 unpaid back-dividends. Practically the whole sum passed into the hands of old shareholders, who were entitled to back-dividends; and, *qua* consumer, no one was hurt in the least. Preference shares had changed hands at a premium.

This completed the case for the Company.

Mr. Fitzgerald then proceeded to address the tribunal on points of law. On Saturday, Mr. W. B. Keen, Mr. E. H. Stevenson, Mr. Frank Jones, and several local witnesses gave evidence on behalf of the Council; and at the close of a long sitting, the proceedings were adjourned until to-day (Tuesday).

YORK CORPORATION AND THE GAS UNDERTAKING.

Opposition to the Purchase Scheme.

As already announced in the "JOURNAL," the York Corporation have promoted a Bill to obtain power (*inter alia*) to acquire the undertaking of the York Gas Company; and the statutory meeting of ratepayers in regard to the matter was held last Wednesday—the LORD MAYOR (Alderman Sir J. S. Rymer) in the chair. There was only a comparatively small attendance.

Alderman MAYER, in the course of his explanation of the objects of the Bill, said it provided that the limits within which the Corporation might supply gas should extend to a radius of seven miles around the city. The maximum price specified was 2s. 6d. per 1000 cubic feet within a two-mile radius, and 6d. extra outside. The provisional agreement between the Corporation and the Gas Company set forth that the Corporation should pay the Company a sum equal to £102 10s. per cent. upon £370,000 ordinary and £50,000 preference stock, £5000 compensation to the Directors, and allowances to officials who might not be retained by the Corporation. The sale was also subject to the rights of the debenture holders. The Bill gave authority for raising a further £99,000 of capital for the extension and improvement of the works, no part being applicable to renewals of the existing undertaking; and the period of repayment sought was 45 years. Moving a resolution approving of the portion of the Bill relating to the Gas Company, Alderman Mayer said he did so with the entire conviction that there was never a commercial proposition made to the people of York of greater value, or better worth their acceptance. They were asked why they were content with what they achieved in opposing the Gas Company's Bill. In the first place, they were advised that considerable reductions in the future would be made in the cost of producing gas. The new carbonizers were effecting a saving of 4d. per 1000 feet at least, and the whole of the extensions of the plant would be made on these lines.

The substitution of the calorific for the illuminating power test of the gas was worth at least £3000 a year in the manufactured cost of the article; and he could not help thinking that this money ought to go to the city. The estimated income for the first year was £26,500, which would leave a profit of about £4500; while on the liquid assets, £15,000, and trustee securities amounting to £25,000, they had far more assets than were required to cover the debenture debt of £35,000. In these figures he was not including anything that would be saved on the new carbonizing plant. They were told that the present price of gas (2s. 2d.) was as low as it could reasonably be expected to be. For the three years ending 1902, it was 1s. 11d.: in 1903, 2s.; and he had no sort of doubt that the present price could and would be considerably reduced.

Mr. G. SHARP seconded the motion.

Alderman WRAGGE complained that the Council had had no information given to them as to how the concern was going to be made to pay. The last available balance-sheet of the Company showed only £17,645 profit, though there were two items which, if the works were in the hands of the Corporation, they would not have to pay—viz., £1050 income-tax and £958 Directors' fees, which would increase the profit to £19,658. They were asked to pay nearly half-a-million of money for the whole concern; and sinking fund and interest on this amount over a period of 45 years would amount to £23,000 annually. His contention was that they were paying a fearful price for a broken-down and used-up concern; and also that the proposed enlargement of the area of supply would have the result of increasing the price of gas in the city.

After a discussion which extended to upwards of three hours, the motion was declared to have been carried by a large majority. It is understood, however, that a poll will be demanded.

BURTON CORPORATION GAS UNDERTAKING.

Proposed Extension of the Area of Supply.

At the Town Hall, Burton-on-Trent, last Thursday, Mr. R. C. MAXWELL held an inquiry in regard to an application made to the Local Government Board by the Burton Corporation for a Provisional Order to enable them to purchase the Rolleston and Tutbury gas undertakings, and supply gas in these places.

The TOWN CLERK said the present price of gas in Burton was the low one of 2s. per 1000 cubic feet. A Provisional Order was obtained in 1911 for the Corporation to purchase the gas undertaking of the Barton-under-Needwood Company, and to extend their limits of supply so as to include Barton, Dunstall, and certain parts of the parish of Branstone. The Rolleston undertaking was a private concern in the hands of Sir Oswald Mosley, Bart. The works were established in 1896 to supply his residence, a number of houses in the district, and the public lamps. As a result of the negotiations between the Corporation and Sir Oswald's solicitors, the purchase price of £1500 for the undertaking was agreed upon, and a formal agreement was entered into on Oct. 15, 1912. The Tutbury undertaking was not owned by a gas company working as one, but by Messrs. J. C. Staton and Co., Limited, glass manufacturers, whose predecessors laid down the gas plant to supply their works and factory. They afterwards commenced to supply gas to the residents of Tutbury and part of Hatton. The Corporation had no desire to carry out their proposals in a way that would be unfair to the outside areas. They wanted to have an agreement that would mean substantial advantages to these places, and at the same time would not be unfair to the Burton ratepayers. They intended to supply gas solely from Burton, and they did not desire to manufacture outside the borough. Including the £5000 for the purchase of the two undertakings, the cost of the scheme would be £11,500. The Town Clerk referred appreciatively to the way in which the Burton gas undertaking had been conducted, and said that though in the last few years £36,000 had been spent in extending and improving the works, this substantial sum had been paid entirely out of the gas profits. It had not previously been considered necessary or desirable to approach the Local Government Board for a loan; but they now hoped the Board would grant one of £11,500, and it was suggested that a reasonable time for its repayment would be thirty years. The Tutbury Council said they would be represented at the inquiry to see if better terms could be arranged; but the Corporation could go no farther in their offers than they had done. The present price of gas in Tutbury and Hatton was 3s. 6d. per 1000 cubic feet; the proposed price, 3s. In Rolleston it was 5s. 5d. per 1000 cubic feet; and the proposed price was 3s. 6d.—a decrease of 1s. 11d. per 1000 cubic feet. In Stretton the price was 2s. 10d., which would not be altered.

Alderman *Lowe*, the Chairman of the Gas and Electricity Committee of the Corporation, said that in 1911 the Corporation applied for the Order for Barton; and as a result of negotiations an offer was made by the Tutbury Gas Company; the amount being £3000. Rolleston then came into the negotiations. They had had interviews with the Parish Councils, and only the Tutbury Council had asked for further consideration. The Corporation would supply gas in the districts at a reasonable price; and he had no doubt that they would come to some arrangements.

Mr. *J. Ferguson Bell* said he was well acquainted with the Burton works. They had been reconstructed, and £40,000 spent upon them. The undertaking was well managed, and he thought the consumers were satisfied with the quality of the gas. He considered the proposals under discussion would be to the advantage of the outlying districts; and if they were carried out, the quality of the gas would be better. He also expressed the opinion that there would be increased consumption, because of the facilities which would be given by the Corporation.

Mr. *R. S. Ramsden*, who agreed generally with the preceding evidence, said that during 1911 the sales of gas in the districts mentioned were about 5 million cubic feet, and 6 millions in 1912. With regard to the gas-works at Burton, owing to alterations they had been able to reduce the price of gas considerably. The prices offered to the parishes were as low as the Corporation could go, having regard to all the circumstances.

Other witnesses having spoken favourably of the proposals of the Corporation,

Mr. *S. E. Allen*, the Borough Treasurer, gave evidence which showed that the capital of the gas undertaking was £263,239 (practically one-third of which, or £86,415, has been provided out of revenue), that the outstanding debt on Dec. 31 last was £26,213, that the reserve fund account stood at £7877, and that the annual sale of gas was 363 million cubic feet.

The Inspector having been addressed on the subject of the insertion in the Order of clauses for the protection of roads and bridges, the inquiry closed.

BRADFORD AND THE PRICE OF COKE.

There was a very considerable amount of discussion in the Bradford City Council last week, with reference to a proposal to increase the price of coke 10d. per ton—Mr. Grundy moving, as an amendment, that to the recommendation should be added the words: "Except in the case of coke supplied to householders in 2 cwt. lots, or less."

The amendment was seconded by Alderman Priestman, who remarked that when he began to use coke he paid about 13s. per ton, while with the proposed increase the price would be 18s. 2d. This would place a burden upon the poorer classes who used coke. Alderman Trotter pointed out that if the amendment were passed as it stood, the man who had been in the habit of taking (say) 15 cwt. a week would take the quantity he required in lots of 2 cwt. at a time to avoid the increased price, and the Corporation would be put to the expense of sending carts to his place seven or eight times a week instead of once. On the other hand, Mr. Deighton said that the Gas Committee had had to place contracts for coal for twelve months at about 2s. per ton in advance on the previous price. Consequently they had to charge more for residuals. It was complained that the advanced price of coke would be burdensome to the poorer classes; but 10d. per ton was only ½d. per cwt. The increase was not sufficient to justify a rebate, especially when, as a general principle, rebates were given to big consumers who put the Corporation to the least expense. Mr. Palin asked why all the increased price of coal should be put upon coke. Why did not the Committee put up the price of gas? The people who bought coke were very largely people who could not afford coal; and the Committee would increase the price of coke to them because it was politically inexpedient to raise the price of gas. If the price of coal demanded increased prices for the commodities made from it, every commodity the Committee produced ought to bear the increase, and not just the commodity which was taken by the very poorest people. Mr. Priestley remarked that, so far as he understood the amendment, it meant this: If you bought two bags at a time, you paid no advance; if you bought more than two bags at a time, you paid the advance. Was this businesslike? He contended that if they were to sell coke cheaply, they should sell it cheaply all round. Mr. Smith thought the proper thing to do was to give an instruction to the Gas Committee to devise a scheme which was best calculated to achieve the purpose Mr. Grundy had in view. This could be done much better in Committee. Mr. Mitchell pointed out that it had been stated that only 5 per cent. of the coke went to household consumers; and he expressed the opinion that if they wanted to do anything for the coke trade in Bradford they would have to make the price popular. In reply, Mr. Grundy maintained that the Council were continually discriminating between one class and another in the price of commodities—as in the case of water, gas, and electricity. On behalf of the Gas Committee, Mr. Barraclough said the minute had already come into operation, and it would be extremely awkward to have to go back to the old price now.

This amendment was negatived, as were also several others; and it was then decided to add to the minute: "That the Gas Committee be respectfully asked to consider in what way the poorer people can be supplied with coke."

IMPROVED PUBLIC LIGHTING IN KENSINGTON.

Nearly a year ago, the Kensington Borough Council adopted a scheme prepared by the Lighting Committee as an alternative to an offer made by the Gaslight and Coke Company for improving the street lighting by gas. In addition to the general expenditure out of revenue on public lighting, the scheme provided for a capital outlay estimated at £3800. The Lighting Committee have now presented a report with reference to the matter. They say it has been ascertained that the actual capital outlay involved has been £3737, so far as can be ascertained; but it may be subject to some slight revision. In connection with the carrying-out of the scheme, certain improvements which were not provided for therein have also been made. The street lighting by gas in the borough now consists of 6 lamps with four-light burners, 24; 230 with three-light burners, 690; 697 with two-light burners, 1394; and 3662 with one-light burners—making a grand total of 5770 burners. In the scheme previously referred to, provision was made for the conversion to the inverted burner system of a total of 5525 burners. It will therefore be seen that while the scheme as submitted has been enlarged, the actual capital expenditure in connection with it has been less than the estimated sum.

The Committee learn from the Borough Engineer that the saving in the consumption of gas by the adoption of the inverted burners is nearly 1 cubic foot per burner per hour, and that he estimates the average cost for gas per burner per annum to be £1 9s. 10d. They are of opinion that the inverted burner system which has been adopted in connection with the street lighting in the borough is very satisfactory. They are proposing to report as to the expenditure on revenue account; giving a statement as to actual annual cost compared with the estimate of £13,960 submitted in February, 1911, so soon as the improved system has been in force for a complete year.

LIGHTING THE WATFORD WORKHOUSE.

Gas v. Electricity.

The question of the lighting of the Workhouse has lately been under the consideration of the Watford Board of Guardians, whose proceedings in the matter have resulted in an explanation being required from them by the Local Government Board. The position will be made clear by what follows.

Early in October last, the Secretary of the Gas Company addressed the following letter to the Local Government Board: "Some time ago our Local Board of Guardians, whom we supply with gas, had under consideration the question of lighting the Watford Workhouse with electricity supplied by the Watford Urban District Council. When this came to our notice in one of the local papers, we wrote to the Clerk of the Guardians pointing out that the matter was one which affected the ratepayers, of whom we are one of the largest, and therefore competitive prices should be asked for. This had the effect of putting off the proposed substitution of gas by electricity; and the matter was referred back to the Committee appointed to deal with the lighting. Subsequently we received an application for estimates for relighting the institution with up-to-date burners, which was duly sent in. Our price of gas is 2s. 6d. per 1000 cubic feet. I have heard within the last day or so that the Guardians called the Electrical Engineer before a meeting held to consider tenders, and on his promise to instal electricity throughout the building for the sum of £300, with a guarantee that this sum will be paid off by the first two years through the cost of lighting—that is, that the saving will amount to £150 per annum—the Guardians decided to make the change. Our account with the Guardians amounts to £210 per annum; and this, therefore, suggests that the whole of the Union can be lighted for some £60 per annum. Might I respectfully suggest that you ask the Guardians to give the matter further consideration, and that the whole of the facts should be laid before you, as I am quite confident that you will see it is impossible to make anything like the saving the electricity undertaking promise, but that it will rather result in an increased expenditure for the Watford ratepayers."

To this letter the Local Government Board replied on the 10th ult., to the effect that no application for sanction to a scheme of lighting the Workhouse by electricity had been received from the Guardians. A copy of the advertisement which appeared in the "Watford Observer" was also sent to the Board by the Secretary of the Gas Company, who wrote further: "As I gather from your letter that no application has been made to the Local Government Board in respect of the funds required for this alteration, may I ask if it is not necessary for the Guardians to do so, and if the necessary authority has not been received, what step I should take as a ratepayer to bring the matter before the Local Government Board."

The matter came before the Guardians at their meeting last Wednesday, when the Clerk (Mr. F. Wilson) said that the Local Government Board asked for their observations. He suggested that he should reply, setting out the facts of the case and the reports of the Gas Company and the Electrical Engineer. No loan was required for the carrying-out of the work in question. If the Gas Company wished, they could attend the audit of the Guardians' accounts, and make any protest they thought justified against the proposed expenditure on electricity.

The Board agreed to this suggestion, and instructed the Clerk to act in the matter.

NEW SHOW-ROOMS AT OLDHAM.

Opening by Mrs. Cloudesley Brereton.

Excellently arranged new show-rooms in connection with the Oldham Corporation Gas Department were opened on Monday of last week. The show-rooms, which contain a representative display of gas appliances for domestic and industrial purposes, are situated in the Market Hall, Henshaw Street. It was explained by Alderman H. Wilde, J.P. (the Chairman of the Gas Committee), that the intention was not to compete with private traders, but rather to stimulate their business. They desired to educate people to know and to use the various appliances for the use of gas which had now been brought to such perfection, and so help to abate the smoke nuisance and assist people also to save money by eliminating a great deal of the dirt which the use of coal involved. The Oldham Corporation had been in the van in popularizing the use of gas-cookers, and the Committee thought they ought to go forward and keep in the front.

The show-rooms were opened by Mrs. M. A. Cloudesley Brereton (who is well known to our readers as the Editor of the official publications of the British Commercial Gas Association); and she gave an excellent address on the place of gas appliances in the Public Health Campaign. She emphasized the use of gas show-rooms both to sellers and to buyers, and the advantage of such show-rooms being carefully co-ordinated with the already existing departments, so that the indoor staff of the show-room are in intimate touch with the outside staff. Continuing, she said the progress in the use of gaseous instead of solid fuel was owing, firstly, to the fact that private citizens began to realize that it was to their interest to use gas, because it was cleanly, healthy, and economical; and, secondly, public opinion dictated that people should not defile the atmosphere with smoke, &c. Then, again, it was of the utmost importance to consider the waste of human energy; so that gas, in so far as it saved human energy, was a very potent factor in domestic economy. There was evidence that architects and others responsible for housing conditions were alive to the use of gas in modern house planning, from the point of view of personal and public health; and the President of the Bury Society of Architects and Surveyors had quite recently, in the course of his Presidential Address, given striking testimony to the advantages of gas in these directions.

The Barnstaple Gas Company have decided to reduce the price of gas by 2d. per 1000 cubic feet, as from the next meter reading.

CHURCH STRETTON WATER ARBITRATION.

The Award.

In the numbers of the "JOURNAL" for Nov. 26 last (p. 692) and Dec. 10 (p. 856), there was published an account of the proceedings in the arbitration to determine the price to be paid by the Church Stretton Urban District Council for the undertaking of the Church Stretton Water Company, Limited.

On behalf of the Company, Mr. E. Brough Taylor put in a total valuation of £27,211, based on 26 years' purchase, and including 10 per cent. for compulsory purchase. For the Council, Mr. James Diggle expressed the opinion that, in view of all the circumstances, 15 years' was a proper multiplier to take, and that if any sum was allowed for disturbance and re-investment 2 per cent. would be ample. Mr. A. J. Ram, K.C., the Arbitrator, has now made his award, the amount of which is £17,850.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The Scottish Junior Gas Association (Western District) are to visit the Pumpherston Oil-Works on Saturday next. As the Secretary, Mr. David Fulton, points out, it is a privilege for the Association to be allowed to visit these works, and it is expected that there will be a large muster of members on the occasion.

Edinburgh.—On Tuesday, a special meeting of the Town Council was held for the purpose of considering the Bill which is to be promoted in Parliament. Certain of the sections refer to the lighting of the streets, and they are taken chiefly from the Burgh Police (Scotland) Act, 1892, and are intended to be in substitution for the corresponding sections of the Act of 1862, adopted by the Act of 1879. Provision is sought to be made for the lighting in a suitable manner of all the streets and other places within the city which, in the judgment of the Town Council, shall be lighted at public expense. The Gas-Works Clauses Act, 1847, the Gas and Water Works Facilities Act, 1870, the Gas-Works Clauses Act, 1871, and the Gas and Water Works Facilities Act, 1870, Amendment Act, and any Act amending these Acts shall, except as they are expressly varied by the Bill now promoted, be incorporated therein. Penalties up to £10 are sought to be imposed for the wilful damage of lamp-posts, or damage to lamps; and it is sought to recover, as a civil debt, the cost of any lamp that is broken through negligence or accident. It is enacted by clause 98 that if the Corporation shall have given permission to any person to erect any lamp-posts, lamp globes, gas fittings, or other articles, and if the same shall not be kept lighted or otherwise disposed of according to the orders and regulations of the Corporation, the Corporation may take possession of, or remove, the same without compensation being made therefor, provided that such lamp-posts, &c., shall be delivered up to the owner thereof in the event of his claiming the same within six months after such removal, and paying all costs and expenses attending the removal and preservation of the same. Powers are also sought to more adequately safeguard the city's interests in the matter of the alterations of gas and water pipes, and for the better protection of gas mains and pipes than exist at the present time. A good deal of opposition has emanated from those engaged in the manufacture and supply of electric fittings in connection with clause 164, which seeks that the Corporation may provide, sell, let for hire, fix, repair, maintain, and remove, but shall not manufacture, electric motors, fittings, apparatus and appliances for heating, cooking, ventilating, and motive power, and for all other purposes for which electrical energy can, or may be, used, and may provide all materials and work necessary or proper in that behalf, and in respect thereto may demand and take such remuneration or rents and charges, and make such terms and conditions, as may be agreed upon. Before the provisions of the Bill were discussed, a deputation on behalf of the electrical trade in the city was heard, and they took strong exception to the Corporation proposals. A plea was put forward for the continuance of the freedom from rate-aided competition to the electrical trade; and it was hinted that if the demands were not acceded to steps would be taken to oppose the Bill when it came before Parliament. The result of the Corporation's deliberations on this particular clause was that they have undertaken not to do any wiring. In all other respects, however, the clause will go forward.

Glasgow.—The consumption of water in Glasgow is increasing to such an extent that Bailie Duncan Graham stated that in about ten years it will be necessary to look for an additional supply, if it is to be kept up to the present high standard.

Aberdeen.—Like many other towns, Aberdeen is feeling the benefit of the gas-fire boom, as the increase in the consumption in the past year is nearly 9 per cent. over the previous twelve months. That the gas-fire and gas-cooker are largely responsible for this increase is borne out by the fact that during the past year the increase in the number of gas-fires has been 40 per cent., and in the case of the gas-cookers (which are now being supplied free) the increase has been as much as 75 per cent.

Alloa.—The consumption of gas for the six months ending October last was 54,386,400 cubic feet, or 10·5 per cent. increase over the corresponding period of last year. Automatic meters account for 35·7 per cent., and gas-engines for 21·4 per cent., or over 57 per cent. of the total consumption. The question of extensions has been in the mind of the Gas Committee for some time, as the Helensburgh Gas-Works and the Dawsholm works of the Glasgow Corporation gas undertaking were visited about a year ago, and the Craigward brickworks have also been recently purchased so as to extend the area of the gas-works. Mr. J. W. Napier, the Engineer of the Gas and Electricity Departments, reported that he had carefully considered the merits of the three systems offered to them, and felt satisfied that the "Wilson-Glasgow" system was the best for the local conditions, and that it

possessed certain advantages superior to any of the other systems. The capital cost of the Wilson-Glasgow system was satisfactory; while the simplicity in working, absence of machinery in withdrawing the coke, and the lower expense for repairs and maintenance all justified its adoption. The installation, which will be carried out by Messrs. R. & G. Hislop, of Paisley, will consist of twenty-four retorts, and will include the coal and coke handling plant. The cost will be about £11,000.

Arbroath.—With a view to obtaining particulars and costs of the latest types of machine stoker, the Gas Manager and the Gas Committee left on Friday as a deputation from the Town Council to visit the gas-works at Dundee, Glasgow, and Perth, to inspect the systems in operation at these places.

Dunfermline.—Opposition to the Provisional Order being promoted by the Dunfermline District Committee for the impounding of a water supply from the River Devon has been intimated from the Perth County Council, as part of the works in connection with it will be situated within the area of the Central District Committee. It is doubtful, however, if this opposition will be necessary, as the various points will no doubt be settled in consultation. In connection with the same Order, the Dunfermline Town Council also decided to oppose the Provisional Order, as the Council's proposal was for a scheme on a smaller scale, by which they intended to take advantage of the Frandy Burn. It is expected that this matter also will be settled before the Provisional Order is examined.

Haddington.—At the monthly meeting of the Town Council on Monday, Treasurer Rattray moved that the Clerk be asked to report as to the powers of the Council to acquire the undertaking of the Haddington Gas Company, and the procedure to be followed in the event of the Council deciding to exercise such powers. Speaking to his motion, Treasurer Rattray said he wished to state that it was brought forward in no spirit of animosity or hostility to the Gas Company, who had in the past served the community so well. If the acquirement of the undertaking were resolved upon, he did not think the shareholders would suffer in the end, for they would get, either by agreement or arbitration, a fair price. In dealing with this question, he had not taken into account whether they would get gas cheaper by the transference—he took a broader and wider view. But, assuming that they obtained the undertaking at a fair price, he did not see why they should not get gas at least as cheaply as at present. Even in view of electric light developments, he thought the last word had not been said with regard to gas, which, he believed, had a very considerable future. The electric light would never be able to do away with it entirely. The motion was unanimously adopted.

Johnstone.—There are twelve names on the leet for the post of Gas Manager to the Johnstone Town Council. The vacancy is consequent upon the death of Mr. R. L. Deans, the former Manager.

Kirkcaldy.—The extension of the gas-works at Kirkcaldy is in contemplation, and Mr. Kincaid, the Engineer to the Corporation, has prepared a plan of the proposal. At a meeting of the Gas Committee, it was decided to submit the plans so prepared to Mr. W. R. Herring for his report upon them. The expenditure involved will finally amount to about £46,000; but this will not all be required at once.

Lanark.—At the monthly meeting of the Lanark Town Council on Monday, a Committee was appointed to consider the taking over of the gas-works and the probable cost, &c., in connection with doing so.

Loanhead.—The Directors of the Loanhead Gas Company held a meeting last week and decided to instruct their Engineer, Mr. J. B. Scott, of Cowdenbeath, to proceed with the further extensions to the works and plant. A portion of the work was carried out last year; and the increased business of the Company demands the further extension. The new work includes a retort-house and retort-bench, condensers, purifiers, &c.

Perth.—Ex-Bailie Wright has given notice of motion that instructions be given to the Gas Manager that the illuminating power be not less than 26 candles. In moving the adoption of a minute regarding the carbonizing plant at the gas-works, Councillor Allan, at Monday's meeting of the Town Council, touched on the points contained in Mr. Gillespie's report, and said that the minute be remitted to the Gas Manager to take such steps as might remedy the defects mentioned in the report. Ex-Bailie Macpherson, in moving disapproval of the minute, said that a large section of the public had rushed to the conclusion that the cause of the trouble was the stoking machinery; but it was extremely satisfactory to know that this plant had had nothing to do with the breakdown. The ex-Bailie failed to find a seconder; and the minute was accordingly adopted.

Troon.—A peculiar position has been taken up by Mr. Findlay in the Town Conncil. He states that there is severe pressure at the gas-works; and instead of suggesting extensions there, he proposes the introduction of electric light in the burgh. When it is realized that the gas-works are already the Corporation's property, and therefore, one would assume, a business it was desired to improve for the benefit of the ratepayers, one is again struck by the peculiar influence which the word "electricity" has upon the public mind. Surely if there is extreme pressure at the gas-works, the proper course is to extend the undertaking, as pressure, which in this case means excess of business, is a proof of a desire on the part of the inhabitants to use what is at present being supplied to them, and with which they are presumably also satisfied.

New Gas-Works at Cudworth.—The supply has now been turned on from the new gas-works of the Cudworth Urban District Council; and an inspection of the works has been made by the councillors, under the guidance of Mr. Newbigging, who has acted as Engineer for the scheme.

Slough Water-Works.—The Slough Water Committee report that the bill of costs of the Solicitors to the Water Company in connection with the arbitration to determine the price to be paid for the undertaking and the transfer of the concern have been paid after taxation. For the arbitration, the bill delivered was £4044; £1998 being disallowed on taxation. For the transfer, the bill delivered was £52; and this, on being taxed, was reduced to £48. They notify that, among others, the following officers are now employed by the Council: Manager and Engineer, Mr. W. W. Cooper; Inspector, Mr. A. Sainty.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan.* 18.

Sulphate of Ammonia.

No further advance in values has to be recorded during the present week, but there has not been any sign of weakness in the position of this article, and prices have been fully maintained at £14 6s. 3d. to £14 7s. 6d. per ton f.o.b. Hull, £14 8s. 9d. to £14 10s. per ton f.o.b. Liverpool, and £14 10s. to £14 11s. 3d. per ton f.o.b. Leith. Consumers both in this country and abroad have shown more disposition to operate, which, coupled with the purchasing by middlemen, has readily absorbed the current production—now at about its maximum. It is reported that £14 12s. 6d. per ton f.o.b. Liverpool has been paid to makers for January-April delivery, and the same figure f.o.b. Hull for February-April, while many producers are holding for still more money.

Nitrate of Soda.

The market for this material continues very firm at 11s. 7½d. per cwt. for 95 per cent. and 11s. 9d. for 96 per cent. quality, on spot.

LONDON, *Jan.* 20.

Tar Products.

The markets for tar products are very steady. Pitch is firm, and improved prices have been paid for delivery over the whole of this year. In some ports, as much as 2s. a ton over last week's quotations has been paid. Benzols are quiet, but prices remain steady. Solvent naphtha is quiet; but there has been no further lowering in the value. Heavy naphthas are in fair demand. Crude carbolic is somewhat unsatisfactory. Consumers will not at the moment pay the prices asked by the distillers. Creosote is very firm; and further business has been done at the equivalent of to-day's quotations.

The average values during the week were: Tar, 29s. 9d. to 33s. 9d. Pitch, London, 47s. 6d. to 48s. 6d.; east coast, 47s. to 48s.; west coast, Clyde, 47s. to 47s. 6d.; Manchester, 45s. to 46s.; Liverpool, 45s. 6d. to 46s. 6d. Benzol, 90 per cent., naked, London, 10½d. to 11d.; North, 9½d. to 10d.; 50-90 per cent., naked, London, 10½d. to 10⅝d.; North, 10d. to 10¼d. Toluol, naked, London, 10½d. to 11d.; North, 10d. to 10½d. Crude naphtha, in bulk, London, 5½d. to 5⅝d.; North, 5d. to 5½d. Solvent naphtha, naked, London, 1s. 1d. to 1s. 1½d.; North, 1s. 1d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10½d. to 11d. f.o.b. Creosote, in bulk, London, 3½d. to 3¾d.; North, 3⅝d. to 3¾d. Heavy oils, in bulk, 3½d. to 3⅝d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 2s. 1d. to 2s. 2d. Naphthalene, £5 to £9; salts, 45s. to 50s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market remains very firm, although there has not been a large amount of new business during the past week. Actual Beckton is quoted at £14 for forward delivery. Outside London makes are £13 15s.; Leith, £14 10s. to £14 12s. 6d.; Liverpool, £14 10s. to £14 12s. 6d.; Hull, £14 8s. 9d.; Middlesbrough, £14 8s. 9d.

COAL TRADE REPORTS.

Northern Coal Trade.

There is rather a firmer tone in the northern coal trade now that the effects of the storm are passing away. In steam coals, best Northumbrians are from about 15s. 3d. to 15s. 6d. per ton f.o.b., second-class steams are 14s. 3d., and steam smalls are from about 11s. to 11s. 6d. There is a full production; but it is well taken up on the whole, and forward inquiries are heavier. In the gas coal trade, the settlement of the Copenhagen contracts has given the first definition this year of the prices that are likely to rule in these large forward sales. In all, about 185,000 tons have been allotted for "special" Durham gas coals, at 20s. 4½d. to 20s. 7½d. per ton, delivered at the Danish port named; and, in addition, there are 30,000 tons of best qualities at 19s. 9d. to 20s. 1½d. per ton. It is rather difficult to say what the freight may be; but if it be estimated at 5s. 6d., it will be seen that the f.o.b. price is a little below that now current. The f.o.b. prices quoted are now about 15s. 6d. to 15s. 9d. per ton; second-class gas coals are about 14s. 9d.; and "Wear" specials are about 16s. The output is very well taken up, though it is tolerably clear that the fullest pressure of demand for this season has now been met. In the coke trade, the tone is steady. Gas coke is in fair request—good makes being 21s. to 21s. 6d. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

All the branches of the Scotch coal trade are fully employed, and prices remain firm. On the Glasgow Coal Exchange on Friday, the following prices f.o.b. Glasgow were quoted: Steam coal, 13s. 6d. to 14s.; splint, 14s. 6d. to 15s.; ell, 13s. to 13s. 6d.; trebles, 13s. 6d. to 14s.; doubles, 13s. to 13s. 6d.; and singles, 12s. 6d. to 13s.

Gas Workers' Hours and Wages at Penrith.—At the meeting of the Penrith Urban District Council last Wednesday, a report was presented with regard to negotiations which had taken place with the National Union of Gas Workers for increased pay and better conditions for the stokers and enginemen at the gas-works. A deputation from the men and the Union had met the Gas Committee; the first objection being to the twelve-hour shifts. It was recommended that stokers and enginemen should work eight-hour shifts; that the pay should be changed to 5s. 6d. per shift to the leading stokers on each shift, and 5s. 3d. to all others, and 4s. 6d. per shift to enginemen; the duties of all to continue as at present, and the change of conditions to take place on April 1. The Union accepted the Council's terms. Mr. Smith said the Committee considered the time had come when a twelve-hour shift was out of the question. He was not able to give the Council any idea as to what the extra cost would be. The arrangement was ratified.

Concessions to Oldham Municipal Workers.

As the result of considerable negotiation, the wages question in the Oldham Corporation Gas Department may now be regarded as settled. At last Wednesday's meeting of the Gas Committee, a deputation headed by Mr. Fleming Eccles, of the Gas Workers' and General Labourers' Union, attended and asked the Committee to concede a minimum wage of 6½d. per hour for store-room keepers, and double time for work on Good Fridays and Christmas Days; and that gas-fitters be paid an increase of ½d. per hour. The Committee discussed the matter in sub-Committee, and decided in the case of the store-keepers that, as they are paid a certain sum per week and not by the hour, and worked eight hours without a break, they could not be granted the 6½d. per hour. But the Committee offered them an advance of 1s. per week, and to grant an advance of ½d. per hour to the gas-fitters; making their wages 8½d. per hour. These terms were accepted by the men. The Committee had also before them an application for an advance in wages from the removal inspectors, who are at present paid at the rate of 31s. per week—the same as the other inspectors. It was generally agreed that the removal inspectors had more onerous duties than the ordinary inspectors; and the Committee decided to recommend the Council to grant them an extra 1s. per week. The adjourned question of wages of outdoor labourers was considered by the Water Committee at last week's meeting, when information from other departments of the Corporation was available. The men have hitherto received 5½d. per hour, paying their own tram fares when sent out on duty. The Committee decided to make themselves responsible for these fares, and to grade the men as in other departments; the scale of wages being 5½d., 5¾d., and 6d. per hour—the latter being paid to experienced men.

According to the Paris correspondent of the "Daily Mail," a young couple were found dead in bed last Thursday morning—the room being full of gas. They had forgotten to turn off the tap of the gas supply to the stove, and it is stated that the pressure split the india-rubber connecting-pipe.

According to a communication received from the New York Correspondent of "The Times," the result of an inquiry by the Public Utilities Commission of New Jersey has been the announcement by the Gas Company of a reduction of 20c. (from 110c. to 90c.) per 1000 cubic feet in the price of gas throughout the State, to take effect on the 1st of May next.

Mr. Edward Sandeman, M.Inst.C.E., who has for the past twelve years been engaged on the construction of the Derwent Valley Water-Works, of which he was the designer, and who had previously designed and constructed the Burrator reservoir, &c., for the Plymouth Corporation, has commenced private practice at 17, Victoria Street, Westminster, and intends to apply himself specially to works of water supply and drainage, and matters connected therewith.

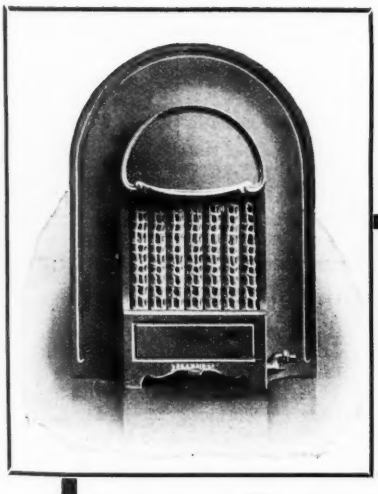
Dangers of Electric Wires.—An exciting scene was witnessed in Penistone Road, Sheffield, early on the morning of the 11th inst., when four men received severe shocks and two horses were killed through the falling of a telephone wire which crossed the tramway trolley wires and became highly charged with electricity. The wire had broken down under the weight of the snow, and just as it fell two cabs were going into the road. The wire struck the horse of the first cab, killing it instantly and burning a large hole in its chest. It then struck the second horse, which was also killed instantly, and was found afterwards with the end of the wire in its mouth. The two drivers jumped from their cabs, and were rescued with difficulty from a very dangerous position.

Opposition to the Epsom Urban District Council Bill.—A meeting of the electors of Epsom was held last Wednesday to consider the Bill promoted by the Urban District Council to obtain further powers in regard to their water and electricity undertakings. With reference to the former, it was stated by Mr. J. Tryon, the Chairman of the Parliamentary Committee of the Council, that the Bill contained a provision for the creation of a reserve fund. In Epsom they were blessed with one of the cheapest water supplies in the kingdom; but as the place grew further works would have to be executed, and a reserve fund would ensure them being carried out as far as possible without borrowing. As to the electricity undertaking, the Council wanted to provide facilities for the small user of power to instal his fixtures; and they were therefore making provision for selling and fixing electric fittings. The Council could not, however, sell such fittings or undertake the wiring of private property except through a contractor carrying on his business independently of the Council; and the clauses had been drawn so as not to result in what might be called municipal trading. Mr. Longley opposed the Bill on behalf of the Epsom Traders' Association. He said it sanctioned municipal trading; and, though such a system might be excused or justified under certain circumstances, it was not required in a little place like Epsom. A resolution approving of the promotion of the Bill was lost by a very large majority.

It was announced at the meeting of the West Ham Town Council last Tuesday that the King had fixed upon March 15 as the date for the opening of the Chingford reservoir.

Excitement was caused at Parkeston Quay on Monday evening last week by the fusing of the electric cables, which caused all the electric lights to go out. Mr. H. Brakes, the Resident Engineer, was soon on the scene, and with his staff quickly had the damage repaired.

The cost of the water-works improvements at Niton, Isle of Wight, to the Ryde Town Council has been £17,980. An excellent supply of water has now been obtained; and it is estimated that a saving will be effected to the extent of 70 per cent. Mr. J. Mackay, the Contractor, claimed £6141, of which the Corporation admitted £4106; and the amount awarded to him was £4891. The Council have authorized the Water Committee to arrange the payment of the balance.



In many types of fuel now upon the market structural strength has been sacrificed for the sake of obtaining instantaneous (more or less) incandescence. The result is extreme fragility, constant breakages, and heavy expense in maintenance.

FIRES FOR HIRE.

The new improved fuel in our "D.S.O." Fires, while of a brilliant appearance, is strong—in fact it is the strongest on the market. It does not require to be manœuvred into position, as there are no obstructions to be avoided, and is therefore not likely to be broken when fitting. As it leans back against the brick, it will not fall out in front.

MAIN MEANS MINIMUM MAINTENANCE.

R. & A. MAIN, LIMITED,

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; 13, Whitworth Street West, MANCHESTER; 8, Exchange Place, Donegall Street, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

GAS COMPANIES' STOCK AND SHARE LIST.

The Stock Exchange has just concluded one of its quietest weeks. Business was very slack; and the general attitude was one of waiting and watching. The new conference between Turkey and the Great Powers (*vice* the Balkan Powers superseded) seemed destined to drag its slow length along; while, looking at home, the eye found nothing to brighten it in contemplating Ulster, Welsh Church, Insurance, or Franchise questions. So things have been preponderantly dull, with occasional slight oscillations in which the upward movement was but feeble. The opening on Monday was rather depressed. Foreign politics and bad weather were the chilling factors; and prices were lower all round. Government issues went heavily, and Consols fell ⅛ money and account. Rails languished at lower figures; and Americans were despondent. On Tuesday, new business was scanty—it was account week—and the chief departments were quite flat. Consols lost another ¼ money and account. Rails fell lower; and Americans were much depressed under Wall Street influence. Wednesday took a turn for the better—clinging hopefully to the chance of the Powers' card to the Porte proving a trump. Consols were steady, and Rails a little more cheerful. Thursday was dead quiet, and markets shrank from sheer inanition; but Americans effected a slight recovery. Friday opened doubtfully, but gathered a little strength later upon hopeful views touching Eastern affairs. Consols were firm, and Rails steadier, though business was quiet. On Saturday, business was at a minimum. Most of the markets made no demonstration; but Consols were in some demand and rose ⅛, closing at 74⅞ to 75⅛—a fall of ⅛ in the week. In the Money Market, the conditions at first were easy, with an ample supply. But rates hardened later, and closed firm. Business in the Gas Market was more animated than in recent weeks; and the general characteristic was marked firmness. One or two issues were more than usually active. Foremost among these was Gaslight and Coke ordinary, which was in good demand and full of rise, transactions advancing steadily from 106¼ to 107⅞—a rise of one in the quotation. The secured issues were firm; the maximum realizing from 84 to 85 (a rise of ½), the preference 100 and 102, and the debenture from 76 to 76¾. South Metropolitan commanded rather higher prices—from 117 to 118—but the quotation was left unchanged. In Commercials, the 3½ per cent. changed hands at 103, and the debenture at 72. Among the Suburban and Provincial group, Alliance and Dublin was marked at 76, British at 45¼, South Suburban at 118 special, and Tottenham "B" at 116 and 117. On the local Exchange, Liverpool "A" realized 225, ditto "B" 162, and ditto debenture 99. In the Continental companies, Imperial was rather quiet, and changed hands at 174½ to 176, ditto debenture was done at 87 to 88, and Union at 84 to 85½. Among the undertakings of the remoter world, Buenos Ayres debentures marked 93½, Monte Video 12 13/16, Primitiva 6½ and 6⅝, and ditto preference from 5 1/16 to 5 3/16.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 11	5	Alliance & Dublin Ord.	73—78	..	6 8 2
374,000	,,	Jan. 16	4	Do. 4 p.c. Deb.	81—84*	..	4 15 3
280,000	5	Oct. 11	7½	Bombay, Ltd.	6½—7	..	5 7 2
50,000	10	Aug. 29	15	Bourne- 10 p.c.	29—30	..	5 0 0
332,000	10	,,	7	mouth Gas B 7 p.c.	15½—16½	..	4 6 2
75,000	10	,,	6	and Water Pref. 6 p.c.	14—14½	..	4 2 9
380,000	Stk.	Aug. 14	13½	Brentford Consolidated	257—262	..	5 3 1
390,000	,,	,,	10½	Do. New	198—203	..	5 3 5
50,000	,,	,,	5	Do. 5 p.c. Pref.	116—118	..	4 4 9
206,250	,,	Dec. 12	4	Do. 4 p.c. Deb.	94—96	..	4 3 4
218,230	Stk.	Aug. 29	11	Brighton & Hove Orig.	210—215	..	5 2 4
244,200	,,	,,	8	Do. A Ord. Stk.	152—155	..	5 3 3
530,000	20	Sept. 27	12½	British	44¼—45½	..	5 9 11
120,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. Stk.	89—91	..	4 7 11
245,771	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	92—94	..	4 5 1
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	3½—4½	..	—
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	71—75	..	6 0 0
167,150	Stk.	Aug. 29	5	Chester 5 p.c. Ord.	110—112	..	4 9 3
1,513,280	Stk.	Aug. 29	5/9/4	Commercial 4 p.c. Pref.	106—108	..	5 1 2
560,000	,,	,,	5½	Do. 3½ p.c. do.	102—104	..	5 2 6
475,000	,,	Dec. 12	3	Do. 3 p.c. Deb. Stk.	71—73	..	4 2 2
800,000	Stk.	,,	4	Continental Union, Ltd.	83—86	..	4 13 0
200,000	,,	,,	7	Do. 7 p.c. Pref.	130—132	..	5 6 1
492,270	Stk.	—	5⅝	Derby Con. Stk.	124—125	..	4 12 0
55,000	,,	—	4	Do. Deb. Stk.	103—105	..	3 16 2
1,002,180	10	Jan. 16	10	European, Ltd.	18½—19½*	..	5 2 7
16,160,600	Stk.	Aug. 14	4/17/4	Gas 4 p.c. Ord.	106—108	+1	4 10 1
2,600,000	,,	,,	3½	light 3½ p.c. max.	83—85	+½	4 2 4
4,062,235	,,	,,	4	and 4 p.c. Con. Pref.	100—102	..	3 18 5
4,531,705	,,	Dec. 12	3	Coke 3 p.c. Con. Deb.	75—77	..	3 17 11
258,740	Stk.	Sept. 13	5	Hastings & St. L. 3½ p.c.	91—93	..	5 7 6
82,500	,,	,,	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Oct. 11	11	Hongkong & China, Ltd.	16—16½	..	6 13 4
131,000	Stk.	Sept. 13	7⅝	Ilford A and C	154—157	..	4 17 1
65,780	,,	,,	6½	Do. B	121—123	..	4 19 7
65,500	,,	Dec. 30	4	Do. 4 p.c. Deb.	89—91	..	4 7 11
4,940,060	Stk.	Nov. 14	9	Imperial Continental	173—178	..	5 1 1
1,235,000	Stk.	Aug. 14	3½	Do. 3½ p.c. Deb. Red.	87—89	..	3 18 8
200,242	Stk.	Aug. 29	6	Lea Bridge Ord. 5 p.c.	122—125	..	4 16 0

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
561,000	Stk.	Aug. 29	10	Liverpool United A	223—225	..	4 8 11
718,100	,,	,,	7	Do. B	161—163	..	4 5 11
306,083	,,	Dec. 20	4	Do. Deb. Stk.	98—100	..	4 0 0
63,480	Stk.	Jan. 16	3	Maidstone 3 p.c. Deb.	68—70*	+½	4 5 9
75,000	5	Nov. 28	6	Malta & Mediterranean	4⅝—4¾	..	6 6 4
250,000	100	Oct. 1	4½	Met. of Melbourne 4½ p.c. Deb.	99—101	..	4 9 1
541,920	20	Oct. 30	3½	Monte Video, Ltd.	12½—12¾	+¼	5 9 10
1,775,892	Stk.	July 26	4½	Newc'tle&G'tesh'd Con.	100½—101½	..	4 6 2
529,705	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.	85½—86½	..	4 0 11
55,940	10	Aug. 29	7/7/0	North Middlesex 7 p.c.	13½—14½	..	5 1 5
300,000	Stk.	Nov. 28	8	Oriental, Ltd.	125—130	..	6 3 1
60,000	5	Sept. 27	10	Ottoman, Ltd.	8¼—8⅝	..	5 14 3
60,000	50	Aug. 14	13	Portsea, Island B	127—130	..	5 0 0
100,000	50	,,	12	Do. C	124—127	..	4 14 6
249,980	5	Oct. 11	8	Primitiva Ord.	6¼—6⅜	..	5 18 6
499,960	5	Dec. 30	5	,, 5 p.c. Pref.	5—5¼	..	4 15 3
521,600	100	Dec. 2	4	,, 4 p.c. Deb.	96—98	..	4 1 8
346,198	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	92—94	..	4 5 1
275,000	5	Apl. 12	12	San Paulo, Ltd.	13—14	..	4 5 9
150,000	10	Sept. 27	6	Do. 6 p.c. Pref.	11½—12	..	5 0 0
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	49—51	..	4 18 0
135,000	Stk.	Aug. 29	10	Sheffield A	231—233	..	4 5 10
209,984	,,	,,	10	Do. B	230—232	..	4 6 2
533,500	,,	,,	10	Do. C	229—231	..	4 6 7
90,000	10	Sept. 27	7½	South African	9½—10½	..	7 2 10
6,429,895	Stk.	Aug. 29	5/9/4	South Met., 4 p.c. Ord.	116—118	..	4 12 8
1,895,445	,,	Jan. 16	3	Do. 3 p.c. Deb.	74—77*	−½	3 17 11
209,820	Stk.	Aug. 14	8½	South Shields Con. Stk.	164—166	..	5 2 5
605,000	Stk.	Aug. 14	5/16/8	S'th Suburb'n Ord. 5 p.c.	118—121	..	4 16 3
60,000	,,	,,	5	Do. 5 p.c. Pref.	117—119	..	4 4 0
117,058	,,	Dec. 30	5	Do. 5 p.c. Deb. Stk.	118—120	..	4 3 4
594,740	Stk.	Nov. 14	5	Southampton Ord.	102—105	..	4 15 3
120,000	Stk.	Aug. 14	7½	Tottenham A 5 p.c.	142—145	..	5 0 0
483,940	,,	,,	5⅞	and B 3½ p.c.	115—117	..	4 18 3
149,470	,,	Dec. 30	4	Edmonton 4 p.c. Deb.	92—94	..	4 5 1
182,380	10	,,	5	Tuscan, Ltd.	8—8½	..	5 17 8
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	96—98	..	5 2 0
286,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	115—115½	..	4 6 7
255,636	Stk.	Aug. 29	6⅞	Wands- B 3½ p.c.	139—142	..	4 16 10
85,766	,,	Dec. 30	3	worth 3 p.c. Deb. Stk.	63—70	..	4 5 9

Prices Marked * are "Ex. Div."

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

MANAGER (Coke-Oven). Box 540, G.P.O., Manchester.
CHEMIST (Second). Bristol Gas Company. Applications by Jan. 29.
REPRESENTATIVE (Meters). No. 5686.
FOREMAN (Geyser Manufacturer, &c.). No. 5690.
CANVASSER. No. 5687.
GAS FITTER. Cradley Heath Gas Company.
GAS FITTERS. Rushden and Higham Ferrers Gas Company.
MAIN AND SERVICE LAYER. No. 5688.

Appointments, &c., Wanted.

CHARGE OF WATER-WORKS. No. 5689.

Gas-Works for Sale.

"THE PINES," Summerseat, Manchester.

Plant (Second-Hand) for Sale.

CENTRE VALVE FOR PURIFIERS. Devizes Gas-Works.

Books (Second-Hand) for Sale. No. 5685.

Meetings.

BARNSTAPLE GAS COMPANY. Bridge Hall, Barnstaple. Feb. 15. Twelve o'clock.
GASLIGHT AND COKE COMPANY. Chief Offices. Feb. 7. Twelve o'clock.
SOUTH METROPOLITAN GAS COMPANY. De Keyser's Hotel. Feb. 12. Two o'clock.
SOUTH SUBURBAN GAS COMPANY. De Keyser's Hotel. Feb. 14. Three o'clock.
TOTTENHAM AND EDMONTON GAS COMPANY. 639, High Road, Tottenham. Feb. 8. Three o'clock.

TENDERS FOR

Coke Breeze.

SWANSEA GASLIGHT COMPANY.

Gasholder (Addition).

BARNOLDSWICK URBAN DISTRICT COUNCIL. Tenders by Feb. 3.

General Stores, Workmen's Tools, Lime, &c.

OSSETT CORPORATION. Tenders by Feb. 8.
SALFORD GAS DEPARTMENT.

Purifiers.

CLACTON URBAN DISTRICT COUNCIL. Tenders by Feb. 5.

Roof, &c.

CLACTON URBAN DISTRICT COUNCIL. Tenders by Feb. 5.

Tar.

DEWSBURY CORPORATION. Tenders by Jan. 30.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

Subscribers who desire to avail themselves of the reduction in the Subscription by paying in advance for the Year 1913, are reminded that this can only be done during the current month.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

United Kingdom: One Year, 21s.; Half Year, 10s. 6d.; Quarter, 6s. 6d.
Payable in advance. If credit is taken, the charge is 25s. a year.
Abroad (in the Postal Union): £1 7s. 6d., payable in advance.

All Communications, Remittances, &c., to be addressed to
WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
Telegrams: "GASKING, FLEET, LONDON." Telephone: P.O. 1571a Central.